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## Factors Associated with Lifestyle Modification for Type 2 Diabetes Self-Management and Prevention

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FACTORS ASSOCIATED WITH LIFESTYLE MODIFICATION FOR TYPE 2 DIABETES  
SELF-MANAGEMENT AND PREVENTION

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DISSERTATION

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A dissertation submitted in partial fulfillment of the  
requirements for the degree of Doctor of Philosophy in the  
College of Nursing  
at the University of Kentucky

By  
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Lexington, Kentucky  
Director: Dr. Gia Mudd-Martin, Associate Professor of Nursing  
Lexington, Kentucky  
2021

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## ABSTRACT OF DISSERTATION

### FACTORS ASSOCIATED WITH LIFESTYLE MODIFICATION FOR TYPE 2 DIABETES SELF-MANAGEMENT AND PREVENTION

Diabetes is the seventh leading cause of death in the United States, affecting roughly 13% of U.S. adults aged 18 years or older. Type 2 diabetes accounts for 90-95% of all diabetes cases and is characterized by the progressive development of insulin resistance leading to sustained elevated blood glucose levels. Management of type 2 diabetes includes risk-reduction strategies and continuous medical care to prevent the development of complications.

Lifestyle is a major contributing factor to morbidity and mortality rates in the United States. Preventative health behaviors, such as engaging in physical activity, maintaining a healthy weight, and following a healthy dietary pattern, are key for reducing risk for the development of type 2 diabetes and aid in the prevention of complications associated with diabetes, such as cardiovascular disease. While engaging in a healthy lifestyle has shown to prevent or delay the development of chronic diseases and their associated complications, few individuals adhere to all recommended self-management behaviors. The purpose of this dissertation is to increase understanding of the factors surrounding type 2 diabetes self-management and prevention through lifestyle modification.

This dissertation includes three original manuscripts that focus on the barriers to self-management and prevention of type 2 diabetes among individuals with or at risk for developing type 2 diabetes. The first manuscript is a qualitative descriptive study examining the barriers, facilitators, motivators, and strategies for engaging with dietary management of type 2 diabetes and heart failure among individuals dually diagnosed with these chronic diseases and their family caregivers. The second manuscript is a secondary analysis to examine psychosocial predictors (anxiety, depression, and fatalism) of a high versus low quality diet at baseline, and predictors of response to a healthy lifestyle intervention by assessing pre- and post-intervention diet quality. The third manuscript is a cross-sectional study examining the impact of the COVID-19 global pandemic on type 2 diabetes self-management and distress and whether attendance of the Diabetes Self-Management Education and Support program had an impact on diabetes self-management and distress during the pandemic. The findings of this dissertation will inform providers of the specific factors surrounding type 2 diabetes self-management and prevention, particularly as it relates to lifestyle modification.

KEYWORDS: Type 2 diabetes, self-management, lifestyle modification, diabetes prevention, diet quality, COVID-19

Leigh Anne Koonmen

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*(Name of Student)*

07/01/2021

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Date

FACTORS ASSOCIATED WITH LIFESTYLE MODIFICATION FOR TYPE 2 DIABETES  
SELF-MANAGEMENT AND PREVENTION

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## DEDICATION

To my grandparents, Mamaw and Pop, and Grandma and Grandpa Koonmen, who taught me the value of hard work and what having a strong work ethic can help you achieve, while still maintaining the importance of making time for family.

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I would first like to acknowledge and thank my family and friends for their never-ending support and encouragement throughout this doctoral program. To my partner, Michael DeNotto, who joined me during this program and has supported me throughout our relationship with care packages full of comforting junk food, encouraging cards (“You Got This”), and by always rooting for me even when I was having a hard time rooting for myself. To my parents: my mom, who has been my greatest cheerleader since the moment I decided to pursue my PhD, and my dad, who has encouraged me to try my hardest at everything I do in order to achieve my dreams (“Hello, Dr. Koonmen”). Thank you to my Aunt Pam and Uncle Gene, who always let me take over their kitchen counter when I was having a hard time focusing at my own house. Thank you to all the friends I met during my time in the PhD program, especially Kaitlin Voigts Key, whose feedback, encouragement, and commiseration has been vital throughout this journey; and to Kathy Collins who has played so many important roles throughout my time in this program, and who I will always consider the glue that holds us students together. And a special thank you to my dog, Murphy, who throughout the writing of this dissertation used his beagle howl and shepherd herding to ensure I maintained work-life balance whenever my working time ran over by literally yelling at me (AWOO-WOO-WOO!!!) and herding me out of my office to play.

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## CHAPTER 1. INTRODUCTION

### 1.1 Diabetes Risk

Diabetes is the seventh leading cause of death in the United States and affects 13% of the U.S. adult population aged 18 or older.<sup>1,2</sup> It is projected that by 2030 rates of diagnosed diabetes in the U.S. will increase to 13.9% and by 2060 will be as high as 17.9%.<sup>3</sup> Given that previous projections underestimated diabetes prevalence, without intervention the future burden of diabetes in the U.S. could be even higher than current projections estimate.<sup>3,4</sup> Furthermore, diabetes cost the U.S. approximately \$327 billion in direct and indirect expenses in 2017, a 26% increase from 2012.<sup>5</sup> Based on current estimations, by 2030 diabetes-related costs will climb to more than \$620 billion.<sup>5,6</sup> Considering the projected increase in rates of diabetes and the high costs of treating the disease, the need for interventions aimed at preventing diabetes and its related complications is imperative. This is particularly true of type 2 diabetes, a preventable form of diabetes that accounts for 90-95% of all diabetes cases.<sup>1</sup>

Type 2 diabetes is a chronic condition characterized by a progressive development of insulin resistance, often over several years, in which the cells of the body fail to respond normally to insulin.<sup>7</sup> Insulin is a hormone produced by the pancreas that moves blood glucose into the body's cells for energy.<sup>7,8</sup> Typically, the body responds to an increase in blood glucose by producing enough insulin to move the excess blood glucose into the cells.<sup>7</sup> In type 2 diabetes, the pancreas is unable to produce enough insulin or does not use the insulin produced appropriately in order to move blood glucose into the cells, resulting in sustained, elevated blood glucose levels.<sup>7,8</sup> Uncontrolled, this can lead to serious health problems such as poor circulation resulting in limb amputation, neuropathy, blindness, and kidney disease.<sup>9,10</sup> Individuals with type 2 diabetes are also twice as likely to develop cardiovascular disease (CVD), as the microvascular complications associated with hyperglycemia contribute to higher risk for stroke, myocardial infarction, coronary artery disease, and peripheral vascular disease.<sup>11-14</sup> Further, CVD is the leading cause of death among individuals with type 2 diabetes.<sup>14</sup>

## 1.2 Cardiovascular Disease Risk

Cardiovascular disease affects nearly half of all U.S. adults and is the leading cause of death in the U.S.<sup>15</sup> A number of heart and vascular conditions comprise CVD, including atrial fibrillation, congestive heart failure, coronary heart disease, hypertension, myocardial infarction, and stroke.<sup>16,17</sup> Among all chronic diseases, CVD is the most costly chronic disease, with \$555 billion spent on costs associated with CVD in 2016.<sup>16</sup> Current estimates project that more than 130 million U.S. adults will have some form of CVD by 2035.<sup>15</sup> Furthermore, costs associated with direct and indirect expenses associated with CVD are expected to climb to \$1.1 trillion by 2035.<sup>15</sup> It is estimated that 47% of Americans have at least one of the three major risk factors for developing CVD, which include smoking, hypertension, and hypercholesterolemia.<sup>18</sup>

## 1.3 Self-Management and Prevention of Diabetes and CVD

Many risk factors for type 2 diabetes and CVD are shared. These include non-modifiable factors, such as older age, family history, and race and ethnicity, with African Americans, Hispanics/Latinos, American Indians, Asians, and Hawaiians and Pacific Islanders being at higher risk than non-Hispanic Whites.<sup>8,16,19</sup> These also include modifiable risk factors, such as engagement in healthy behaviors such as physical activity, healthy diet, and management of weight, blood pressure and cholesterol levels.<sup>20-22</sup> For people who have type 2 diabetes or CVD, risk factors for developing disease-related complications are similar to those for developing the disease, including modifiable risk factors. For example, healthy dietary practices and physical activity in combination with medication and management of weight, blood pressure, and cholesterol are as critical for glycemic control and for decreasing risk for microvascular complications among persons with type 2 diabetes as they are for disease prevention among those who are at risk for diabetes.<sup>1,13,23</sup>

Given these commonalities, reducing risk for development of type 2 diabetes as well as risk for diabetes-related complications necessitates self-management that blends engagement in healthy lifestyle behaviors and medical management. This is upheld by current guidelines from the



American Diabetes Association (ADA), which recommend engagement in intensive behavioral lifestyle interventions that include management of body weight, engagement in a minimum of 150 minutes per week of moderate-intensity physical activity, and eating a healthy diet to prevent type 2 diabetes.<sup>24</sup> It is also well established that consumption of a diet rich in whole grains, fruits and vegetables, low in saturated fat, red or processed meats, and refined sugars reduces risk for diabetes.<sup>25-30</sup>

The ADA similarly advises that adults with type 2 diabetes participate in programs that promote healthy lifestyles, such as the Diabetes Self-Management Education and Support (DSMES) program.<sup>22</sup> The DSMES program focuses on promoting patient self-management by providing foundational knowledge and skills to help people with diabetes to identify and implement self-care strategies, cope with diabetes and related complications, and actively work with members of the healthcare team to make informed decisions regarding diabetes care.<sup>22</sup> The DSMES program has been shown to effectively improve diabetes knowledge, engagement in self-management behaviors, and quality of life, as well as lower A1C, decrease weight, and reduce the onset or progression of diabetes-related complications.<sup>22,31</sup> Despite the breadth of evidence supporting the effectiveness of the DSMES program, few individuals with type 2 diabetes receive self-management education through the DSMES program, with only 6.8% of newly diagnosed individuals receiving DSMES education within the first year of diagnosis.<sup>31</sup> A joint position statement from the ADA, the Association of Diabetes Care and Education Specialists (ADCES), and the Academy of Nutrition and Dietetics stresses that it is imperative that future efforts to increase engagement with diabetes self-management focus on addressing barriers to access to DSMES services.<sup>31</sup>

The DSMES program was developed by the CDC and the Association of Diabetes Care and Education Specialists, formerly the American Association of Diabetes Educators, and is guided by the ADCES 7 Self-Care Behaviors<sup>®</sup>, a framework that provides self-care recommendations for people living with diabetes by focusing on those outcome measures with the greatest impact.<sup>31-34</sup>

The ADCES 7 Self-Care Behaviors<sup>®</sup> framework focuses on 7 core self-care behaviors: healthy coping, healthy eating, being active, taking medication, monitoring, reducing risk, and problem solving.<sup>32-34</sup> This framework has been used to guide behavior change that leads to more effective self-management in order to improve health outcomes and quality of life among individuals with diabetes.<sup>32,34</sup> The ADCES 7 Self-Care Behaviors<sup>®</sup> were modified in 2020 to place healthy coping at the forefront of these self-care behaviors, as healthy coping is considered critical for mastering other self-care behaviors.<sup>32</sup> The research conducted for this dissertation focuses on assessing ADCES 7 Self-Care Behaviors<sup>®</sup>, particularly healthy coping, healthy eating, and reducing risk, to better understand engagement in these self-management behaviors in high-risk populations as well as high-risk environments.

#### 1.4 Family Involvement in Management and Prevention

Family and caregiver support has also been shown to play a critical role in adherence to self-management and prevention recommendations among individuals diagnosed with chronic diseases.<sup>35,36</sup> Greater family involvement is associated with better self-management, including dietary adherence and better health outcomes among individuals with diabetes and CVD.<sup>35,37-39</sup> Additionally, self-management behaviors, such as diet and exercise, have been shown to improve when dyads work together to develop self-management strategies.<sup>40</sup> While dyadic involvement has been demonstrated to influence patient adherence to self-management recommendations, research on self-management adherence at the dyadic level among individuals with comorbid conditions is limited. This dissertation addresses this gap in the literature by examining the factors surrounding management of a dual low sodium-diabetic diet as experienced by dyads of patients with a comorbid diagnosis of type 2 diabetes and heart failure as well as their family caregivers.

## 1.5 The Health Belief Model

Complementing the ADCES 7 Self-Care Behaviors<sup>®</sup> framework, the research conducted for this dissertation was guided by the Health Belief Model (HBM) as shown in Figure 1.1. This model was developed in the 1950s by social psychologists working with the U.S. Public Health Service to explain people's lack of participation in disease screenings and prevention services in order to increase the effectiveness of these programs.<sup>41,42</sup> The model was later expanded to guide understanding of individuals' responses to disease diagnosis and management of disease symptoms.<sup>41</sup> According to this model, individuals take action based on the value they place on a particular health outcome and how likely a health behavior is to achieve that outcome.<sup>41</sup> Therefore, if an individual perceives a disease or disease-related complications as a threat, perceives themselves as being susceptible to the disease or related complications, and perceives preventative behaviors as beneficial, then they are more likely to engage in healthy behavior change.<sup>41,43</sup>

The factors influencing individuals' decisions to take action make up the six constructs of the HBM: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy.<sup>41,44,45</sup> *Perceived susceptibility* represents the individual's beliefs about how likely they are to develop a particular disease, whereas *perceived severity* is the individual's beliefs about how serious the disease is and the seriousness of the consequences if left untreated. Combined, perceived susceptibility and perceived severity make up the individual's *perceived threat* of the disease. *Perceived benefits* refers to the individual's belief in the effectiveness of an action to reduce the risk or consequences of developing the disease, whereas *perceived barriers* refers to anything the individual believes may hinder their ability to take action or any negative aspects the individual associates with taking action.<sup>41,44</sup> *Cues to action* refers to triggering mechanisms, such as bodily or environmental events, that increase an individual's desire to make behavior modifications that will reduce their risk for a disease or consequences of a disease. The final construct, *self-efficacy*, was later added to the model and refers to an individual's confidence in their ability to take action and execute a behavior modification.<sup>41,46,47</sup>

The HBM has been used to predict health-related behaviors and factors that influence an individual's decision to take action to prevent or take control of disease processes and to guide development of interventions aimed at modifying health behaviors.<sup>41</sup> The model has guided many interventions aimed at improving self-management behaviors in individuals with type 2 diabetes or those at risk for the disease.<sup>48-50</sup> The HBM has also been invaluable in guiding research aimed at predicting health behaviors, particularly those behaviors related to prevention and self-management of type 2 diabetes and related complications.<sup>41</sup>

## 1.6 Purpose of Dissertation

The purpose of this dissertation was to examine factors contributing to engagement in self-management behaviors among individuals with or at risk for developing type 2 diabetes. The chapters of this dissertation demonstrate the development of a program of research focused on diabetes prevention in those at risk and self-management in those with diagnosed diabetes through lifestyle behaviors.

Importantly, type 2 diabetes and CVD have shared risk factors and CVD is the most common comorbid condition in type 2 diabetes as well as the most common cause of mortality.<sup>11,12,14</sup> This is unsurprising, given that macrovascular and microvascular complications of diabetes commonly affect cardiovascular health resulting in hypertension, peripheral vascular disease, coronary artery disease, and myocardial infarction.<sup>14,51</sup> Because of the high rate of comorbidity as well as shared self-management strategies, two of the three studies conducted addressed self-management in persons with or at risk for both type 2 diabetes and CVD.

The specific aims of this dissertation were to: 1) explore the barriers, facilitators, motivators, and strategies to dual low sodium-diabetic diet adherence among individuals with a comorbid diagnosis of type 2 diabetes and heart failure and their family caregivers at the individual and dyadic level, 2) examine predictors of high and low diet quality among individuals at risk for type 2 diabetes and CVD and response to a healthy lifestyle intervention as indicated by pre- to

post-intervention diet quality, and 3) determine the impact of the COVID-19 pandemic and DSMES program attendance on diabetes self-management and distress among individuals with type 2 diabetes.

### 1.7 Summary of Subsequent Chapters

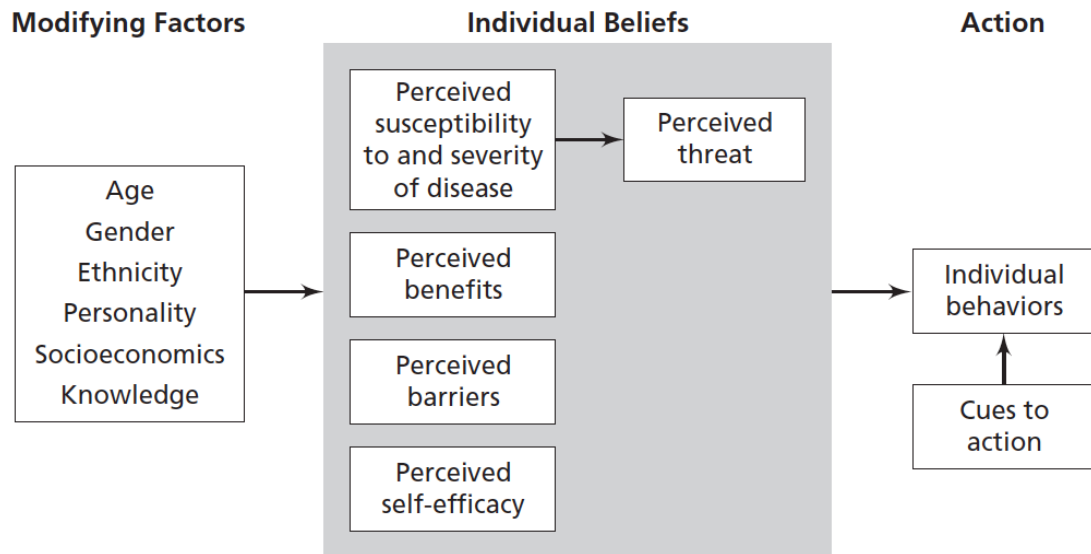
In order to better understand the factors surrounding self-management of risk and disease complications associated with type 2 diabetes, I conducted three novel studies that make up the body of this dissertation. First, I conducted a qualitative study to explore the barriers, facilitators, motivators, and strategies to maintaining a dual low sodium-diabetic diet among dyads that included patients with a comorbid diagnosis of type 2 diabetes and heart failure as well as their family caregivers. The second study I conducted was a secondary analysis of data from the Heart Health in Rural Kentucky (HeartHealth) study. The purpose of this analysis was to determine the psychosocial factors that contribute to diet quality in at-risk for type 2 diabetes and CVD who engaged in a healthy lifestyle intervention with a focus on strategies to improve dietary intake patterns. Finally, I conducted a survey study to assess the impact of the COVID-19 pandemic on diabetes self-management behaviors.

Chapter 2 presents the findings of a qualitative study exploring the barriers, facilitators, motivators, and strategies to dual low sodium-diabetic diet management among patients with type 2 diabetes and heart failure as well as their family caregivers. A total of 12 patient-caregiver dyads participated in one-hour semi-structured interviews and provided insight into the barriers and facilitators to adhering to a dual low sodium-diabetic diet, as well as the underlying motivators and strategies employed by these dyads for better adherence. Awareness of these dyadic barriers, facilitators, motivators, and strategies can better assist healthcare providers tailor dual dietary recommendations for patients and caregivers in the context of their complex needs. The findings from this study provide a foundation for future interventions tailored to address the specific needs of this population that incorporate the family perspective.

Chapter 3 presents the results of a secondary analysis of data examining predictors of high versus low diet quality and response to a healthy lifestyle intervention among individuals at risk for type 2 diabetes and CVD using logistic regression. Data for 689 participants were included in this analysis. The 2010 Healthy Eating Index was used to measure participant dietary patterns pre- and post-intervention. Predictors included in the logistic regression models were sociodemographic information, including age, sex, marital status, education level, employment status, financial comfort, and body mass index; health literacy, measured using the Newest Vital Sign; anxiety, measured using the Brief Symptom Inventory; depressive symptoms, measured using the Patient Health Questionnaire-9; and fatalism, measured using the CVD Fatalism Scale. The results from this study provide a more comprehensive understanding of factors that influence diet quality pre-intervention and those factors that influence response to a healthy lifestyle intervention.

Chapter 4 reports on the findings of a web-based survey study conducted to measure the impact of the COVID-19 pandemic on self-management practices among 86 individuals with type 2 diabetes. Patients were eligible to participate if they had been diagnosed with type 2 diabetes, were 18 years of age or older, had been seen at the University of Kentucky Healthcare Barnstable Diabetes Center or referring clinics, had an email address located in the electronic medical record, and had access to an electronic device compatible with the online survey system. Measures included in this study were sociodemographic information, including age, sex, race and ethnicity, marital status, educational level, employment status, financial comfort, and diabetes duration; COVID-19 impact, measured using the Coronavirus Impact Scale; diabetes-related distress, measured using the Diabetes Distress Scale; and diabetes self-management, measured using the Self-Management Profile for Type 2 Diabetes. The findings from this study can aid in the development of future interventions to address the specific needs of individuals with type 2 diabetes in times of crisis.

Figure 1.1 Health Belief Model



## CHAPTER 2. QUALITATIVE DESCRIPTION OF DUAL LOW SODIUM-DIABETIC DIET MANAGEMENT BY PATIENT-CAREGIVER DYADS

### 2.1 Introduction

It is estimated that 35-45% of individuals with heart failure have a concurrent diagnosis of type 2 diabetes.<sup>1,2</sup> Individuals with a type 2 diabetes diagnosis have two times the risk of developing heart failure than do those individuals without a diabetes diagnosis.<sup>3-5</sup> Diabetes is one of the leading risk factors for developing heart failure, as the two are pathologically similar.<sup>1,3</sup> Moreover, type 2 diabetes alone contributes to the development of heart failure and increases the risk of mortality among individuals diagnosed with heart failure.<sup>1,3</sup> Risk factors for type 2 diabetes and heart failure are similar and include obesity, high blood pressure, advanced age, sleep apnea, high cholesterol, anemia, chronic kidney disease, and heart disease.<sup>3</sup>

Individuals with type 2 diabetes and heart failure, who participate in self-care behaviors such as maintaining a healthy diet, have better health outcomes, improved symptom management, and reduced disease complications compared to those who do not follow self-care recommendations.<sup>6,7</sup> However, patients find adherence to the diabetic diet the most difficult of the recommended self-care practices, and only 7% of individuals with type 2 diabetes follow all dietary recommendations.<sup>8,9</sup> Similarly, adherence to a low sodium diet is the cornerstone of heart failure self-management, yet only 22-55% of individuals with heart failure adhere to the diet.<sup>10</sup> In studies examining barriers to self-management adherence among individuals with type 2 diabetes, lack of time, perceived control, social support, and knowledge were frequently reported barriers.<sup>11,12</sup> However, barriers specific to dietary adherence among patients with a concurrent diagnosis of type 2 diabetes and heart failure are limited.

To overcome barriers to dietary adherence, research has shown that some patients and family members use mutual coping strategies to jointly participate in recommended self-management activities associated with improved dietary adherence. Such coping strategies include



common dyadic coping, a mechanism that enables patients and family caregivers to work together to reduce stress through problem solving.<sup>13</sup> Family support through strategies, such as common dyadic coping, has been shown to improve dietary adherence among patients with diabetes.<sup>13,14</sup> Moreover, family caregiver support has been found to facilitate dietary adherence among patients with type 2 diabetes as well as among those with heart failure.<sup>10,11,15,16</sup> A systematic review of qualitative research exploring challenges to dietary modification experienced by patients with diabetes or heart disease highlighted the critical role of family support to dietary adherence in diabetes as well as in heart disease.<sup>17</sup> Other studies investigating the effect of family involvement on type 2 diabetes outcomes have shown self-management and diabetes control to improve with greater family involvement.<sup>18,19</sup> In a study among heart failure patients following a low sodium diet, Chung et al. found that patient dietary adherence improved when the dyadic family member also adhered to the diet.<sup>15</sup> To date, barriers and facilitators to dual low sodium and diabetic dietary adherence experienced by patient-caregiver dyads are limited.

Given that family involvement has shown to influence diet quality and adherence to medically prescribed diets, we were interested in exploring the specific barriers, facilitators, motivators, and strategies to adhering to a dual low sodium-diabetic diet as experienced by patients with a dual diagnosis of type 2 diabetes and heart failure and their family caregivers. Therefore, the purpose of this qualitative study was to explore the factors surrounding low sodium-diabetic diet adherence among patient-caregiver dyads. The specific aims of this study were to:

1. explore the barriers, facilitators, motivators, and strategies to adhering to a dual diet as experienced by patients with a concurrent diagnosis of type 2 diabetes and heart failure and their family caregivers at the dyadic level; and
2. explore the barriers, facilitators, motivators, and strategies to adhering to a dual low sodium-diabetic diet as experienced by patients with a concurrent diagnosis of type 2 diabetes and heart failure and their family caregivers at the individual level.

## 2.2 Methods

### 2.2.1 Study Design

Qualitative description was used to identify, explore, and understand phenomena through the subjective perspectives, meanings, and accounts of those directly involved or affected by the phenomenon.<sup>20,21</sup> This approach applies an inductive process to provide a summarization of phenomena, events, and experiences as defined by those who experienced them.<sup>20</sup> Qualitative description is especially useful for research conducted to gain insight from study participants about phenomena that are not well understood.<sup>22</sup>

### 2.2.2 Sample and Setting

Purposive sampling was used to recruit participants with a concurrent diagnosis of type 2 diabetes and heart failure from two longitudinal randomized controlled trials: the Family Sodium Watchers Program (FamSWaP) study and the Rural Intervention for Caregivers' Heart Health (RICHH) study. The FamSWaP study was conducted to examine the effectiveness of a dyadic intervention to improve adherence to a sodium-restricted diet among patients with heart failure.<sup>23</sup> The RICHH study was conducted to examine the efficacy of an intervention to reduce cardiovascular disease risk in family caregivers of individuals with chronic diseases through a healthy lifestyle intervention.<sup>24</sup> Eligible participants for the FamSWaP study were those who had a diagnosis of heart failure and a dedicated family caregiver; were at least 21 years of age; and were able to speak and write English. Eligibility for the RICHH study were primary caregivers of an individual diagnosed with a chronic illness; were 21 years of age or older; and were living in a rural area. Exclusion criteria for both studies were a diagnosis of terminal cancer; active substance use disorder; and physical or emotional impairment that would limit participants' ability to engage in an education intervention.

We invited dyads who were consented to participate in the FamSWaP or RICHH studies. In addition to meeting eligibility criteria for the FamSWaP and RICHH studies, participants were

eligible for this leveraged study if the patient had a comorbid diagnosis of type 2 diabetes and heart failure and a designated family caregiver. Participants were recruited by email and invitations sent by mail. Follow-up phone calls were conducted approximately two weeks after invitation letters had been sent to allow prospective participants time to consider involvement. Additional recruitment methods included direct contact by a nurse interventionist familiar with eligible participants enrolled in the two ongoing longitudinal studies. Of 17 dyads invited, 12 consented to participate. No compensation was provided for participation in this qualitative study. All procedures were approved by the University of Kentucky Institutional Review Board.

### 2.2.3 Procedure

Data were collected using semi-structured interviews following an interview guide with additional probes designed to gain deeper insight into responses (see Appendix). Interviews were conducted once and included both members of the dyad; each interview lasted approximately one hour. The interviews were conducted using the video chat programs FaceTime and Zoom via iPads provided to the dyads by the original study from which they were recruited. Participant dyads joined the interviews from their homes; the author conducted the interviews alone in a private office to maintain confidentiality. Participants were informed of and verbally consented to the recording of the interviews prior to the start of the interview. Interviews were recorded using the secure Echo360 software program contracted through the University of Kentucky and a handheld recording device as backup. Interviews were later transcribed verbatim by a HIPAA-compliant transcription service (Rev) and reviewed and verified for accuracy by two of the authors. All interview recordings were deleted upon completion and verification of transcription. To maintain anonymity, all participants were assigned pseudonyms in interview transcripts; patient participants were assigned names beginning with “p,” and caregiver participants were assigned names beginning with “c.” Audit trails were used to account for trustworthiness of information. Data collection began in April 2017 and concluded in August 2018.

#### 2.2.4 Data Analysis

The process of thematic analysis was used. For this, two of the authors (LAK and KVK), through a process of immersion, coded the interviews separately, identifying themes that emerged from the data.<sup>25,26</sup> Once the coding was completed for the first three interviews, they were compared, and initial codes were generated. This provided a guide for coding the remaining interviews, with additional codes added as they emerged from the data. The process of coding and interviewing continued until the two coders agreed that saturation was reached. Initial themes were determined through a review of codes generated through independent analysis conducted by the two authors. Final themes were determined, and a third author (GMM) reviewed the themes for purposes of verification. All authors agreed on the finalized themes as best representing the experiences of the dyads gleaned from the interviews.

### 2.3 Results

#### 2.3.1 Sample

Of the 12 patient-caregiver dyads that participated in the study, the majority of the patient participants were Caucasian (75.0%), male (83.3%) and ranged in age from 40 years to 83 years with a mean age of  $60.6 \pm 14.35$  years. The majority of caregiver participants were Caucasian (75.0%), female (83.3%), and ranged in age from 25 years to 75 years with a mean age of  $57.0 \pm 14.96$  years. Two caregivers were diagnosed with type 2 diabetes; none of the caregivers had a diagnosis of heart failure.

#### 2.3.2 Dyadic Themes

Dyadic themes were those themes identified by both members of the dyad as having an influence on dietary adherence. The majority of themes that emerged during interviews were at the dyadic level, with patients and caregivers identifying shared barriers, facilitators, motivators, and strategies for dietary adherence.

### 2.3.2.1 Barriers to Dietary Adherence

Among the commonly identified barriers to adherence to dual dietary recommendations were authorized lapses. Authorized lapses were defined by dyads as times in which the patient participants were permitted by caregivers to eat foods restricted by dietary guidelines. Such lapses were typically used to maintain the patient's sense of autonomy. Caregivers often felt lapses ought to be permitted and that the patients were capable of making their own choices regarding management of the dual diets; however, some caregivers acknowledged authorized lapses occurred because the caregiver was unsure of when it was appropriate to intervene, fearing that they were infringing on the patient's autonomy.

Closely tied to authorized lapses, non-supportive caregiver behaviors were reported by both patients and caregivers as a barrier for dietary adherence. Most commonly identified was the caregiver practice of rewarding the patient for successful adherence by giving them foods that were restricted. This is exemplified by the patient of one dyad who explained: *“One of the barriers that is for this diet, honestly, is my husband is too kind in his words. Because it is a problem. I can't do that; you know what I mean? I don't have that option with all these diagnoses. And my husband's very kind and he's like, well you've been good, you can go ahead and try it.”* Other identified caregiver practices that presented a barrier to adherence were increasing temptation by eating foods restricted on the diet in the presence of the patient and leaving the patient to figure out meals on their own.

Availability of restricted foods was another frequently reported barrier to dietary adherence. Dyads identified this to be most common when “bringing the foods into the house” after grocery trips or when restricted food items were stocked for other members of the family (e.g., children). Among the greatest temptation for selecting restricted foods was when hunger levels had exceeded interest in adhering to dietary recommendations. Some dyads also reported food taste to be a barrier to adherence to the dual diet. As stated by one patient, *“Food don't taste as good. I'm hoping I'll get used to it, so it'll taste as good when I get used to it. But, I mean, it don't taste nearly*

*as good as what I'm used to eating.*" At the same time, several dyads who identified this barrier stated they were "getting used to" the taste of foods that met dietary restrictions.

Eating out was identified by some dyads as a barrier, with patients and caregivers feeling that their options were limited at restaurants, since many restaurants do not provide foods consistent with the dual diet. Eating out was often associated with healthcare appointments, as many of the patients had frequent appointments that required the dyads to drive long distances. Some dyads reported attending appointments multiple days a week, necessitating them to be away from home for six or more hours per day. Dyads stated that frequent doctor appointments made it difficult to plan meals or prepare food ahead of time, which meant most meals were eaten out. As summed up by a caregiver, *"That's a bad mistake, you know, that when we go to the doctor, we eat out."*

Managing the two diets together was identified by most dyads as a barrier for adherence, with many focusing on one diet over the other. Some dyads reported confusion due to a lack of knowledge about the diets. Underlying the confusion for some was a lack of education about the two diets by their healthcare providers. Others stated that, although they received education about the diets from providers, the education received was often too brief and vague.

Common points of confusion were not knowing what foods qualified as acceptable between the two diets, how many carbohydrates they should have per meal, or what their daily sodium intake limit should be. As stated by the patient participant of one dyad, *"It's confusing to me, very confusing. I don't know what I'm allowed to eat. I can't eat canned foods; everything has to be fresh. Can't have too much carbohydrate because that turns into sugar. I don't know what I'm allowed to eat...I don't understand. And I'm not dumb."* One dyad explained that despite using various resources to learn more about appropriate foods for the two diets, conflicting information among these resources ultimately left her feeling more confused. According to the caregiver of the dyad, *"It's almost like you put them in a hat and whichever one's drawn is the one that you're gonna target that day."*

### 2.3.2.2 Facilitators for Dietary Adherence

All dyads discussed the importance of caregiver support as a facilitator for adhering to the dual diets. Patients frequently identified caregiver support as having a positive influence on their food choices due to the caregiver preparing meals adherent to the dual diets, reminding them when food choices are not adherent, or by providing words of encouragement. Caregivers identified ways in which they were able to provide support for their spouse, such as by preparing and eating meals adherent to the dual diet. In addition to caregiver support, having a good external support system was another common facilitator for dietary adherence identified by dyads. External support systems primarily identified included members of their healthcare teams and the dyad's children. Dyads reported support in the form of recommendations of resources for learning more about the two diets, assistance with household tasks, and words of encouragement. As a patient participant expressed, *“She takes care of me, I mean, totally. Her and, well, my daughter helps her, but probably I look to [the caregiver]. She watches my diet, she feeds me, and she knows what I need to eat, and how much I've eaten. If I go to eat too much, she'll tell me.”*

Juxtaposed to dyads who reported lack of dietary education as a barrier, several dyads did state that formal education they had received on the two diets was a facilitator for adherence. Sources of formal education identified included nutrition-based classes on the diets and information received from primary care physicians and specialists, such as cardiologists, endocrinologists, or dietitians. Education received from specialists, particularly dietitians, was the most frequently identified source of formal education. Some dyads reported receiving education on the two diets from their primary care physician when first diagnosed with type 2 diabetes and heart failure; however, following referrals, they received the majority of information on the two diets from specialists, such as their cardiologists and endocrinologists. Additionally, some dyads reported having received formal education from nutrition-based classes; however, most reported that these classes only focused on one diet (low sodium or diabetic) and the information presented was often repetitive and not as detailed as they had hoped.

Eating at home was also identified by most dyads as a facilitator for adhering to the dual diet. As one caregiver offered, *“We don’t eat out very often, and I think that’s kind of a plus. I can have a little more control over things.”* Some dyads stated cooking at home allowed them to have a better sense of control, as they could prepare meals that adhere to the dual diet recommendations, such as managing the amount of carbohydrates in each meal and the amount of sodium added to a recipe. Others found they made better food choices when cooking at home, such as opting for fresh fruit rather than cookies for a dessert. Eating meals together was another facilitator identified by dyads, as this promoted family involvement in helping the patient with type 2 diabetes and heart failure adhere to the diets. Gardening was also identified as a facilitator for dual diet adherence by some dyads. Some dyads found that gardening and canning fresh foods not only kept them active, but also allowed them to incorporate fresh foods into meals throughout the year. Capturing these sentiments, a caregiver commented:

*I guess more let’s just try to keep some food in the house that is a better choice than if we don’t have it and just grab for the cookies and grab for the crackers and all that. We just try to keep things that we can immediately eat. We read labels for the low sodium; we try to buy no salt added products. And try to keep something handy. Like, we always have grapes, we always have blueberries.*

Most dyads also identified food preferences changing over time as another facilitator for dual diet adherence. Many reported that by making small changes to the way they prepared foods, they became accustomed to the taste of adherent foods. For example, some dyads reported that by slowly reducing their intake of sodium or sugar over time, their preference for nonadherent foods had diminished. As explained by a patient, *“That made the biggest difference. Because we first started with it, one of the things, you could taste the salt, which we don’t need to be able to do that. And we just kept cutting back until we figured out “okay, we need this much less than we used to.” And it’s been working out really well.”* Many found as their preferences changed over time, the foods they previously craved or ate frequently now tasted overly salty, overly sweet, or were overly



laden with carbohydrates. According to another patient *“It has made a difference; I mean I can tell a difference since I’ve cut down on salt. If I get anything with salt in it, it just don’t taste as good, nearly as good as it used to.”*

#### 2.3.2.3 Motivators for Dietary Adherence

Dyads identified motivators for adhering to the dual diet, including being able to stop taking prescribed medications and feeling better overall. Some dyads acknowledged that by adhering to the dual diet they could stop taking medications and manage their heart failure and type 2 diabetes by diet alone, something considered beneficial by both members of the dyad. Similarly, by adhering to the dual diet, while patient participants reported feeling better overall due to improved disease symptoms such as decreased fluid retention, caregivers similarly felt better due to the positive outcomes.

#### 2.3.2.4 Strategies for Dietary Adherence

Dyads discussed strategies utilized to better adhere to the dual diet. One commonly identified strategy was to employ gradual reduction methods for salt, sugar, and carbohydrates. All dyads reported using substitution products, such as Mrs. Dash and artificial sweeteners, for this purpose. In addition to substitution products, dyads also discussed other methods of salt and sugar reduction, such as rinsing canned goods, purchasing low sodium foods, removing the saltshaker from the dinner table, opting for sugar-free foods, and opting for fresh fruit instead of a dessert. Another approach to reduction was to consume smaller portion sizes by using smaller plates or individually packaged snacks and desserts and splitting meals at restaurants.

Counterbalancing reduction in consumption of unhealthy nutrients was increased consumption of fruits and vegetables. Some dyads reported increasing fruit and vegetable intake by ensuring at least half their plate was made up of fruits or vegetables, having salads at meals, incorporating shredded vegetables into dishes such as lasagna, and keeping fruits and vegetables in easily accessible locations. In providing support to their family members, caregivers reported incorporating many of these strategies into their own diets as well.

Food label reading was frequently reported as a strategy for promoting adherence to the dual diet. Most dyads reported reading labels to identify the best options when making food choices. As a patient participant shared, *“The reading labels has really become an everyday thing. When you go to the store, that’s the first thing you do if you’re going to get canned food. As you turn it around, you read the carbohydrates, the sodium, and all that.”*

Almost all dyads discussed the importance of adapting to the diets as a strategy for adherence. Adapting to the diets encompassed forming routines, avoiding restricted foods, choosing restaurants that offer low sodium and diabetic options, and choosing to adhere to the dual diet despite cravings. Many dyads reported adapting by being aware of food choices as an important strategy for adapting to the dual diet.

Dyads who ate at restaurants frequently, either for enjoyment or due to multiple appointments, reported developing adaptation strategies for eating out while still maintaining adherence to the dual diets. Strategies included requesting nutrition information for food items, opting for salads with light dressing, ordering vegetable plates, and sharing entrées. Some dyads found that, by familiarizing themselves with the owners and employees of restaurants, they had developed a new support system in the staff, who would assist them in making food choices adherent to the dual diet. As explained by one dyad, *“We eat out enough at these places that they know us, and we know what they cook. We’re friends with the owners at a lot of places.”*

Meal planning and following specialized diets were also commonly referenced strategies for maintaining diet adherence. Dyads reported trying specialized diets to help them adhere to the dual diet. These diets include the Keto diet, plant-based diets, the glycemic index, the seven-day diet, and the Mediterranean diet and were reported to be helpful for managing sodium, sugar, and carbohydrate intake as well as to help prevent overindulging.

Self-driven research was another strategy identified by dyads to promote dietary adherence to the dual diet, which included utilizing internet-based resources and written materials. Dyads reported using websites for professional organizations, such as the American Diabetes Association

and the American Heart Association, to gather information on the two diets. Other sites frequently referenced included various recipe sites and social media. Written materials included handbooks, pamphlets, hospital newsletters, and food preparation charts.

### 2.3.3 Individual Themes

#### 2.3.3.1 Patient Barriers

Patients identified barriers and motivators separate from those identified at the dyadic level. Strong cravings for restricted foods were reported as a struggle for most participants; however, many stated they worked hard to overcome these cravings. Some patients reported not being aware they had cravings for certain foods until they were no longer allowed to have them. Participants also reported feeling limited by the two diets, as dietary restrictions from both the low sodium diet and the diabetic diet limited the variety of foods they could eat as exemplified by one patient who commented, *“That’s a big barrier, too. There’s only so many different types of food you can eat, which is not good either.”* Overeating and large portion sizes were also reported by participants as a struggle. Similarly, some participants identified sneaking foods and snacking as barriers. Participants acknowledged that sneaking nonadherent foods at night, often without their caregiver’s knowledge, was a barrier for adherence.

Patients acknowledged that although they had the resources and knowledge to adhere to the diet, they were less likely to follow the dual diet recommendations when they felt unwell. For example, one patient stated, *“I’ve got the information, the materials. I just need to apply it when I feel, you know...it’s just so many times that I don’t feel good that I don’t apply it.”* Some also reported feeling overwhelmed and burned out by the difficulty in managing two diets simultaneously, such as knowing which foods were considered adherent and balancing the various components of the two diets.

### 2.3.3.2 Patient Motivators

While caregivers contributed to the discussion of motivators for adherence at the dyadic level, motivators for dual diet adherence were most frequently discussed at the individual level of the patient participant. The most commonly reported motivator for adhering to the dual diet was fear of dying and a desire to live. Participants reported having family and friends who experienced serious complications or death as a result of not adhering to prescribed diets. Some participants reported having come close to death themselves and identified those experiences as a major motivator for adhering to the dual diet. A desire to stay alive for family (spouses, children, and grandchildren) was another major motivator identified by patient participants. As expressed by a participant: *“I have two grandchildren, one just born 5 months ago. I want to live, that’s why.”* Some participants referenced past critical health crises that had a major impact on increasing resolve to adhere to prescribed regimens.

Participants also identified avoiding symptoms of heart failure and uncontrolled type 2 diabetes as major motivators for adhering to the dual diet and attributed eating restricted foods to worsening symptoms and complications of the diagnoses. In addition to reducing the risk for worsening symptoms and complications, participants identified avoiding hospitalization as a motivator for adherence to the dual diet. As expressed by a patient participant, *“I don’t want to go into the hospital, because my sugar’s too high, my salt content’s too high, I’m holding water; you know? All the things in a row, because of bad choices that I’ve made over the past month”*. Some participants also reported improved lab values and weight loss as a motivating factor for maintaining dietary adherence.

### 2.3.3.3 Caregiver Barriers

Management of the various aspects of the dual diet also contributed to caregivers feeling exhausted and overwhelmed and compounded other sources of exhaustion, such as feeling overwhelmed by such caregiving responsibilities as carrying out household tasks and taking care of other spousal health-related needs. Some caregivers acknowledged that feeling overwhelmed

and exhausted often led to lapses in supportive behaviors for dietary adherence as exemplified by one caregiver's comment that "*Sometimes, me being lazy or me being tired, a frozen pot pie comes out of the freezer, and that's the worst thing on both accounts.*"

## 2.4 Discussion

### 2.4.1 Dyadic Barriers

In a report developed by the U.S Department of Agriculture's Economic Research Service, eating away from home has been associated with a poorer diet quality, an increase in calories consumed, increased intake of sodium and saturated fat, and a reduced intake of sources of fiber, such as whole grains and vegetables.<sup>27</sup> These findings mirror those experiences shared by the dyads in this study, who reported eating out as a major barrier to adhering to the dual low sodium-diabetic diet. Dyads in this study reported time constraints as a major influence for eating out, another finding supported by the report<sup>27</sup> and reflected in a study exploring the most commonly reported barriers of dietary adherence among registered dietitians caring for adults with diabetes.<sup>12</sup> Dyads often reported eating out at fast food restaurants between medical appointments as a barrier to adhering to the dual diet, a finding supported by Liem, Miremadi, and Keast, who found approximately 75% of dietary sodium is sourced from meals eaten away from home.<sup>28</sup>

Lack of knowledge regarding the two diets was also identified by dyads as a major barrier to adherence. In a review of the literature, Ahola and Groop found lack of knowledge of self-management recommendations, including dietary recommendations, to be a commonly identified barrier to diabetes self-management.<sup>29</sup> A meta-analysis of interventions aimed at increasing diabetes-related knowledge improved dietary quality and engagement with other self-monitoring practices.<sup>29</sup> Studies conducted by Bentley et al. and Heo et al. similarly found lack of knowledge to be a barrier among patients with heart failure following a low sodium diet.<sup>30,31</sup> Moreover, Bentley et al. also found that many of the participants had to seek out their own information regarding the low sodium diet, a finding reflected in the current study.<sup>30</sup> Studies have also indicated that dyadic

lack of knowledge about heart failure self-management is associated with poorer adherence to low sodium diet but not with other aspects of self-management such as medication management.<sup>32</sup>

Dyads also identified feeling limited by food choices and disliking the taste of adherent foods to be a barrier to adhering to the dual diet. In their study, Bentley et al. found lack of food selections to be a major barrier to adhering to a low sodium diet.<sup>30</sup> Participants in their study also found the taste of adherent foods to be unappealing, a finding similarly reflected by participants in the current study.<sup>30</sup> Feeling limited by food choices was exacerbated when family members ate foods not adherent to the dual diet. In a study exploring the experiences among adults with type 2 diabetes in Appalachia, participants reported feeling the need to avoid temptations and cravings for high sugar or high calorie foods consumed their family members.<sup>33</sup> Both patient and caregiver reports of sneaking non-adherent foods was similarly reported by Lohri-Posey.<sup>33</sup>

#### 2.4.2 Dyadic Facilitators for Dietary Adherence

Similar to identified barriers, many of the facilitators to maintaining adherence to dual dietary recommendations reflect findings from studies conducted to investigate facilitators of healthier eating. For example, eating at home that was frequently reported by dyads as a major facilitator for dual dietary adherence, has also been shown in population studies to be associated with a healthier diet, including diets that meet higher Dietary Approaches to Stop Hypertension (DASH) standards and also more closely reflect consumption patterns similar to those recommended by the Mediterranean Diet.<sup>34</sup> Other facilitators identified by dyads, such as social support, have been found to be positively related to dietary adherence among individuals with type 2 diabetes.<sup>11,29</sup>

In a similar qualitative study exploring barriers and facilitators to self-management among urban-dwelling African American adults with type 2 diabetes, family and peer support was identified as a major facilitator for adhering to self-management recommendations. Results of studies conducted by Chung et al. have similarly suggested that patients with heart failure following a low sodium diet had reduced sodium intake when their spouses also adhered to the low sodium

diet, and a recent review of evidence has identified the best strategy for adherence to low sodium diet is involvement of family members in following dietary recommendations.<sup>10,15,35</sup> These findings, in combination with the findings of the present study, highlight the importance of family involvement in chronic disease management, particularly when considering dietary adherence.

Knowledge about the two diets, via formal education or self-driven research, was also reported by dyads to be a major facilitator for dual dietary adherence. In a study conducted by Geaney et al., adults with higher nutrition knowledge were found to have better diet quality.<sup>36</sup> Alkerwi et al. similarly found a positive association between nutrition knowledge and diet quality.<sup>37</sup> These findings are further supported by a similar study conducted by Chlebowsky, Hood, and LaJoie, in which participants reported having adequate knowledge as a major facilitator for better diabetes management, including dietary adherence.<sup>11</sup>

#### 2.4.3 Dyadic Motivators for Dietary Adherence

Motivators for dietary adherence identified by dyads were discussed in less detail than the other themes and generally included broader concepts. Motivators to adherence reported by dyads included a fear of dying or a desire to stay alive for members of their family, including spouses, children, and grandchildren. Fear of dying was the most frequently reported motivator by patients for adhering to the dual diet. These findings are similarly reflected in an exploration of dietary decisions among individuals who recently experienced a myocardial infarction, in which fear of death was reported as a major motivator for dietary adherence.<sup>38</sup>

#### 2.4.4 Dyadic Strategies

Many of the strategies reported by dyads for dual dietary adherence are supported by recommendations from health organizations. For example, dyads' reported use of salt and sugar substitutes is in accordance with the 2019 Consensus Report released by the American Diabetes Association, which supports the use of sugar substitutes as a method to reduce daily intake of calories and carbohydrates.<sup>39</sup> Additionally, methods for reducing sodium content used by dyads in this study, such as rinsing canned vegetables and using salt substitutes, is in line with current

American Heart Association recommendations for reducing sodium intake.<sup>40</sup> Carbohydrate reduction through low carbohydrate diets has been associated with improved A1C levels, fasting glucose levels, and triglyceride levels among patients with type 2 diabetes.<sup>41</sup>

Being aware of food choices and utilizing food labels were also commonly reported strategies to improve adherence to the dual diet by identifying and avoiding high salt and high carbohydrate foods. In a study on food label use and dietary quality, Miller et al. found food label use to be positively associated with diet quality.<sup>42</sup> Additionally, in a study examining food label use and nutritional awareness among adults with chronic disease, individuals with diabetes were found to utilize food labels more frequently and have higher nutritional awareness.<sup>43</sup> Nutritional awareness has been found to have a direct effect on dietary quality, with greater nutritional awareness being associated with better diet quality.<sup>37</sup>

#### 2.4.5 Patient Barriers

Among the most difficult aspects of adherence to dietary recommendations identified at the individual patient level was management of cravings. The phenomenon of craving is well documented in individuals with diabetes and is known to commonly lead to nonadherence to the diabetic diet.<sup>44</sup> At the same time, food cravings have also been shown to be more prevalent among persons experiencing chronic stress, a common state among persons with diabetes that is closely related to discussion among participants with diabetes in our study who indicated that when they are not feeling well, they have higher cravings.<sup>45</sup> Interestingly, strategies identified by dyads to manage adherence to dual dietary recommendations through consumption of a high protein-low carbohydrate diet or consumption of more fruits and vegetables have similarly been shown to be successful strategies for reducing cravings.<sup>46</sup>

#### 2.4.6 Caregiver Barriers

The most commonly identified barrier at the level of the individual caregiver to supporting patient adherence to dual dietary recommendations was the sense of feeling overwhelmed and exhausted by the caregiving responsibilities. This is unsurprising, given the high prevalence of



stress and burnout among family caregivers of persons with chronic conditions.<sup>47</sup> Caregiver burnout is defined as the negative physical, psychological, and behavioral effects resulting from the chronic stressors associated with caregiving responsibilities, particularly over long periods of time.<sup>47,48</sup> Caregivers of individuals diagnosed with type 2 diabetes experience high levels of burnout and chronic stress, which can contribute to poor health outcomes for the caregiver.<sup>49</sup> Similarly, caregivers of individuals diagnosed with heart failure experience high levels of caregiver burnout and decreased quality of life.<sup>50-53</sup> A recent meta-analysis of studies examining relationships between caregiver health and outcomes among patients with heart failure found that higher caregiver strain was significantly associated with poorer heart failure outcomes as measured by New York Heart Association Class.<sup>54</sup>

## 2.5 Implications

Participants frequently reported experiencing confusion around management of the two diets together and would often focus on the management of one diet at a time. This finding indicates a need for healthcare providers to not only highlight the differences between a low sodium and diabetic diet, but to make management of these dual diets more accessible through highlighting the importance of maintaining a generally well-balanced diet to improve health outcomes.<sup>55</sup> It is imperative going forward that healthcare providers prioritize the importance of an overall healthy dietary pattern through increased intake of fruits, vegetables, and whole grains, as well as the importance of reducing intake of red meat, refined sugars and starches, and processed foods.<sup>56,57</sup> The findings of this study can aid in the development of interventions that address the specific concerns of individuals with type 2 diabetes and heart failure in relation to management of a dual low sodium-diabetic diet by developing approaches that stress the importance of following an overall healthy dietary pattern.

Further, the findings of this study inform what is known about the impact of family involvement in dietary management of chronic diseases. Family engagement with healthy dietary

patterns has shown to increase dietary adherence among patients with chronic diseases.<sup>15,16</sup> The findings of this study further add to what is known about the role of family members in dietary adherence, as the results highlight the notion that patients do not eat in isolation. There is a need for healthcare providers to engage family members and incorporate their involvement in the management of chronic disease management to better improve patient health outcomes.<sup>19,58</sup> The findings of this study can be used to develop interventions that incorporate healthy dietary recommendations at the family level to improve health outcomes for not only the patient, but for all members of the family.

## 2.6 Limitations

As this study used a qualitative design, generalizability of the findings is limited to those who share similar demographics to the participants in this study; however, as highlighted throughout the discussion section, studies of a similar nature exploring the self-management experiences of patients with type 2 diabetes or heart failure have reported findings similar to those themes identified by participants in the current study. Racial and ethnic diversity was also limited in this study and is not representative of the general population of individuals with type 2 diabetes and heart failure; however, the sample of the present study is representative of the sample recruited for the parent study and the clinic population from which participants were recruited. Additionally, interventions for the parent study were aimed at healthy diet education, which could further bias responses provided by participants in the current study; however, one dyad was recruited from the control group and after comparing the themes identified in that interview to those of the other interviews, no major diversions in theme content were identified.

## 2.7 Conclusion

This study explored the barriers, facilitators, motivators, and strategies to dual low sodium-diabetic diet adherence at the dyadic and individual levels for patients with heart failure and

diabetes and their family caregivers. The findings of this study demonstrate that patients and caregivers often work together and share similar barriers, facilitators, motivators, and strategies in their experiences of adhering to a dual low sodium-diabetic diet. These results are useful for guiding the development of interventions to support dietary adherence of patients with heart failure and diabetes as well as to support their caregivers. Future research should focus on intervening with both the patient and caregiver to provide a comprehensive approach that will support adherence to dual low sodium-diabetic diet adherence, particularly given that family engagement with healthy dietary patterns has shown to improve dietary adherence among patients with chronic diseases.

## CHAPTER 3. A SECONDARY ANALYSIS OF PSYCHOSOCIAL PREDICTORS OR DIET QUALITY AMONG APPALACHIAN ADULTS AT RISK FOR TYPE 2 DIABETES AND CARDIOVASCULAR DISEASE

### 3.1 Introduction

Kentucky ranks fifth in the nation for diabetes-related deaths and seventh in the nation for cardiovascular-related deaths.<sup>1,2</sup> In Kentucky, diabetes is the seventh leading cause of death and cardiovascular disease (CVD) is the leading cause of death.<sup>3</sup> Approximately 13% of adults in Kentucky had diabetes in 2019 and 9% reported having CVD, compared to the national median of 10.5% and 6.3%, respectively.<sup>4,5</sup> Individuals in rural Kentucky are among those at highest risk for diabetes and CVD in the nation due to socioeconomic and lifestyle behaviors.<sup>6,7</sup> For example, populations in two rural Kentucky regions rank among highest in the nation for both rates of diabetes and CVD. In the Delta region, the prevalence of diagnosed diabetes among adults 18 years and older ranges from 16.1% to 18.5%; in Central Appalachia, situated in Eastern Kentucky, the prevalence of diabetes is as high as 22.1%.<sup>8</sup> Similarly, in Central Appalachia, mortality due to diabetes is 41% higher and mortality due to CVD is 42% higher than national rates.<sup>9</sup>

Risk factors for developing type 2 diabetes and CVD are similar and include smoking, high blood pressure, abnormal cholesterol levels, being overweight or obese, aged 45 or older, being physically inactive, having prediabetes, and having a family history of diabetes or CVD.<sup>4,10</sup> Of modifiable behaviors that reduce risk for type 2 diabetes and CVD, among the most critical is following a healthy dietary pattern.<sup>11-15</sup> Current dietary recommendations for the prevention or delay of type 2 diabetes and CVD highlight the importance of a nutrient dense diet rich in fiber through whole grains, fruits, and non-starchy vegetables; fish high in omega-3 fatty acids; lean meats, such as skinless poultry; healthy oils low in saturated fat; low-fat dairy products; unsalted seeds, nuts, and legumes; and sodium intake less than 2,300 milligrams per day.<sup>16,17</sup> These dietary

recommendations also include avoiding foods including refined carbohydrates, sweets and added sugars, fatty and processed meats, partially hydrogenated or trans fats, and saturated fats.<sup>16-18</sup>

Psychosocial factors, such as anxiety and depression, negatively impact diet quality and are associated with an increased risk for the development of chronic diseases, such as diabetes and CVD.<sup>19-21</sup> Less well studied is fatalism as a predictor of diabetes and CVD risk. Fatalism is defined as a set of health beliefs regarding the inevitability of death when a serious disease is present and encompasses the dimensions of predetermination, luck, and pessimism.<sup>22</sup> Fatalism is characterized by perceptions of a lack of internal control over external events, beliefs that health and illness are predetermined, and that individuals with serious diseases are powerless against negative health outcomes.<sup>22,23</sup> Higher levels of fatalism have been associated with lower intentions to engage with health behavior change and lower adherence to general health-promoting behaviors.<sup>22,24</sup> However, few studies have been conducted in which both diet quality and fatalism have been measured; even less well studied have been the effects of fatalism, anxiety, and depression on the outcome of a healthy lifestyle intervention addressing diet quality as a major component.

The purpose of this study was to determine the psychosocial factors that contribute to diet quality in persons at risk for type 2 diabetes and CVD who engaged in a lifestyle intervention that included a focus on improving dietary intake patterns. The specific aims were to:

1. determine whether anxiety, depression, or fatalism are predictive of diet quality at baseline among individuals with multiple risk factors for CVD and type 2 diabetes, controlling for age, sex, marital status, education level, employment status, financial comfort, BMI, and health literacy; and
2. examine whether anxiety, depression, or fatalism predict response to a CVD risk reduction intervention as determined by change from pre- to post-intervention diet quality among individuals with multiple risk factors for CVD and type 2 diabetes, controlling for age, sex, marital status, education level, employment status, financial comfort, BMI, and health literacy.

## 3.2 Methods

### 3.2.1 Study Design

We conducted a secondary analysis utilizing existing data from the Heart Health in Rural Kentucky (HeartHealth) study<sup>25</sup> to examine psychosocial predictors (i.e., anxiety, depression, and fatalism) of low and high diet quality at baseline, as well as predictors of group membership regarding response or non-response to a healthy lifestyle intervention as indicated by change in diet quality from pre- to post-intervention.

The HeartHealth study was a two-phase study to test the effectiveness of an intervention to reduce CVD risk among rural Kentuckians residing in the Delta and Central Appalachian regions. A detailed description of the two phases of the HeartHealth intervention has been presented in an article examining fatalism as a moderator between a family history of CVD and engagement in health-promoting behaviors conducted by Mudd-Martin et al.<sup>26</sup> The intervention was characterized by socioculturally-tailored education sessions that integrated recommendations from CVD risk-reduction guidelines. While addressing multiple factors including physical activity, management of comorbid conditions such as hypercholesterolemia and hypertension, smoking cessation, and stress reduction, a significant emphasis of the intervention was on improvement of diet quality. This included education about portion control, balancing protein and carbohydrate intake, increasing consumption of fruits and vegetables, increasing healthy fats and reducing unhealthy fats, and reducing sodium in the diet. Participants also learned strategies for eating healthily in difficult situations such as when eating out as well as ways to improve healthy eating on a budget.

### 3.2.2 Sample and Setting

Participants in the HeartHealth study were community-dwelling adults living in rural Delta and Central Appalachian Kentucky. Inclusion criteria were individuals who had two or more CVD risk factors, including diagnosed hypertension, diagnosed hyperlipidemia, diagnosed type 2 diabetes or HgA1c >7% found during screening, overweight or obese as indicated by a body mass

index (BMI) >25 kg/m<sup>2</sup>, sedentary lifestyle, or unhealthy diet. Additional inclusion criteria for this secondary analysis were complete pre-intervention data on the key variables of interest (age, sex, race and ethnicity, marital status, educational level, employment status, financial comfort, BMI, health literacy, anxiety, depressive symptoms, and fatalism) and pre- and post-intervention data on diet quality as measured by the 2010 Healthy Eating Index total score.

Exclusion criteria were individuals who 1) had diagnosed coronary artery disease, cerebrovascular disease, or a history of acute coronary syndrome or peripheral artery disease; 2) were taking medications (e.g., protease inhibitors) that interfere with lipid metabolism; 3) had cognitive impairment that limited ability to provide informed consent, answer questionnaires, or participate in the intervention; 4) chronic drug use; 5) end-stage renal, liver, or pulmonary disease; 6) were undergoing active treatment for cancer, other than isolated skin cancer treatable by excision; or 7) had gastrointestinal disease that required specialized diets (e.g., Crohn's or celiac disease). Additional exclusion criteria for this secondary analysis were those individuals who had self-reported diagnosed diabetes at baseline or were prescribed medications to treat diabetes.

### 3.2.3 Measures

#### 3.2.3.1 Sociodemographic and Clinical Data

Participants' sociodemographic information was collected at baseline by self-report. This included age, sex, race and ethnicity, marital status, educational level, employment status, and financial status. Although age was reported in years, we categorized participants into three groups based on the literature indicating that adults aged 18 to 30 are at least risk for developing type 2 diabetes or heart disease, with an increase in risk among those aged 31 to 50 years, and a significantly greater increase among persons aged 51 years and older.<sup>27,28</sup> Race and ethnicity were dichotomized as "non-Hispanic White" and "Other" because, reflective of the rural Kentucky population, less than 4% of participants self-identified as "non-Hispanic Black or African American," "Asian," "Hispanic or Latino," "American Indian or Alaskan Native," "Native Hawaiian or other Pacific Islander," or "Other." Marital status was dichotomized as "married or

cohabiting” and “single, widowed, or divorced.” Educational level was dichotomized as “high school or less” and “greater than high school.” Based on participant self-report, employment status was dichotomized as “employed,” which comprised those who had reported working full or part time, and “not employed,” which comprised those who reported being unemployed or retired. To measure financial status, participants were asked to select whether they had more than enough to make ends meet, had enough to make ends meet, or did not have enough to make ends meet, as this has been found to more accurately reflect economic status than income level alone.<sup>26,29</sup> To compare those who had sufficient resources to those who did not, financial status was dichotomized to “do not have enough to make ends meet” and “have enough to make ends meet,” with the latter category representing those participants who reported having enough and more than enough resources to make ends meet.

Clinical data, including participants’ height and weight, were collected at baseline with a professional-grade digital bodyweight scale and stadiometer (shoes and overgarments removed) to calculate BMI following the recommended formula provided by the Centers for Disease Control and Prevention (weight kg/height m<sup>2</sup>).<sup>30</sup> Participants were grouped into three categories based on BMI: normal (BMI  $\leq$ 24.9 kg/m<sup>2</sup>); overweight (25 to  $\leq$  29.9 kg/m<sup>2</sup>); and obese (BMI  $\geq$ 30 kg/m<sup>2</sup>).<sup>30</sup>

#### 3.2.3.2 The Newest Vital Sign

The Newest Vital Sign (NVS), a well-validated 6-item questionnaire that assesses an individual’s ability to read and apply information from a food nutrition label, was used to measure health literacy.<sup>31</sup> Scores for the Newest Vital Sign range from 0 to 6 based on the number of items answered correctly on the questionnaire, with higher scores indicating a higher level of health literacy.<sup>31</sup> For the purposes of this study, health literacy was dichotomized with a cut-off point of 4, as scores  $\geq$ 4 indicate adequate health literacy. Cronbach’s alpha of the NVS for this sample was 0.76, indicating good internal consistency.



### 3.2.3.3 The Brief Symptom Inventory, Anxiety Subscale

The Brief Symptom Inventory (BSI) anxiety subscale was used to measure anxiety. This well-validated self-report measure includes 6 items with response options on a 5-point Likert scale ranging from 0 (not at all anxious) to 5 (extremely anxious). The scores of the 6 items are averaged for a total anxiety score, with higher scores indicating higher levels of anxiety.<sup>32,33</sup> Anxiety was dichotomized into “low anxiety” and “high anxiety” using a cutoff of 0.35, as this has been shown to indicate high anxiety in healthy individuals.<sup>34,35</sup> Cronbach’s alpha of the BSI anxiety subscale for this sample was 0.79, indicating good internal consistency.

### 3.2.3.4 Patient Health Questionnaire-9

The well-validated 9-item Patient Health Questionnaire (PHQ-9) was used to measure depressive symptoms.<sup>36</sup> Scores from this questionnaire are averaged to produce an estimation of depressive symptom severity with a range from 1-27; scores of 1-4 indicate minimal depressive symptoms, 5-9 mild depressive symptoms, 10-14 moderate depressive symptoms, 15-19 severe depressive symptoms, and scores between 20 and 27 indicating the presence of severe depression.<sup>36</sup> For the purposes of this study, depressive symptoms were dichotomized, in which scores  $\geq 9$  indicated high depressive symptoms and those  $< 9$  indicated low depressive symptoms. Cronbach’s alpha of the PHQ-9 for this sample was 0.79, indicating good internal consistency.

### 3.2.3.5 CVD Fatalism Scale

The CVD Fatalism Scale was used to assess participants’ degree of fatalism. The scale is based on a global disease fatalism scale developed by Shen, Condit, and Wright.<sup>24</sup> Revised to measure fatalism related to heart disease,<sup>22,26</sup> many items in the scale are also applicable to fatalism associated with type 2 diabetes such as, “My health is a matter of luck” or “I often feel helpless when dealing with life’s problems” (personal communication with G. Mudd-Martin, author of the revised scale). The 20-item scale uses a 4-point Likert scale with response options from “Never” (1) to “Always” (4). Scores range from 20 to 80, with higher scores indicating a greater degree of fatalism.<sup>26</sup> The reliability of the CVD Fatalism Scale for the HeartHealth study was 0.91.

### 3.2.3.6 Healthy Eating Index-2010

The 2010 version of the Healthy Eating Index (HEI), a well-validated tool for assessing diet quality in accordance with the U.S. 2010 Dietary Guidelines, was used to measure participant diet quality at baseline and immediate post-intervention.<sup>37-39</sup> The HEI-2010 is comprised of 12 components, which include total fruit, whole fruit, total vegetables, greens and beans, whole grains, dairy, total protein, seafood and plant-based proteins, fatty acids, refined grains, sodium, and empty calories from solid fats, alcohol, and added sugars.<sup>37</sup> The final three components of the HEI (i.e., refined grains, sodium, and added sugars) are reverse-scored so that reduced consumption of these items results in higher scores, as these food items are recommended for consumption in moderation.<sup>37</sup> The total HEI score, summed from the 12 components, has a range between 0 to 100, with higher scores indicating a higher-quality diet.<sup>37</sup> Reliability and validity testing of the HEI-2010 revealed this diet quality instrument is sensitive to meaningful dietary changes over time across diverse populations of individuals.<sup>37</sup>

Scores for the HEI-2010 were derived from the VioScreen graphical food frequency questionnaire, a well-validated internet-based self-report dietary assessment tool developed by Viocare Technologies.<sup>40,41</sup> VioScreen measures intake patterns of 156 food items or food groups, including frequency of consumption and method of preparation, and provides participants with photographic examples of foods and portion sizes in order to more accurately measure the nutrition content of their self-reported dietary patterns over the previous 90-day period.<sup>40,41</sup> The VioScreen food frequency questionnaire takes approximately 30 to 45 minutes to complete. Once participants have completed the questionnaire, VioScreen reports data through detailed estimates regarding the participant's food use and nutrient intake patterns.<sup>41</sup>

### 3.2.4 Analyses

To address Specific Aim 1, participants were identified as having a low or high HEI score based on the median baseline HEI total score of the full sample (med=63.65). Similar to the current national mean total score for Americans, the mean total score for U.S. adults was 59 in 2010 during

the timeframe that data for the HeartHealth study was collected; thus the median HEI total score for this sample is representative of national averages.<sup>42</sup> Participants above the median baseline HEI total score were categorized as having a high dietary quality (*high* group); those below the median were categorized as having low dietary quality (*low* group). Descriptive analyses were conducted, using means and standard deviations (SD) or frequency distributions as appropriate to summarize and compare study variables across high or low HEI score. Binomial logistic regression was conducted to examine psychosocial predictors (anxiety, depression, fatalism) of baseline group membership.

To address Specific Aim 2, participants were grouped into one of four groups based on HEI total scores as follows: 1) *Low-Low* group: This included participants whose HEI total scores were below the baseline median at both baseline and post-intervention, indicating these participants had a low quality diet that did not improve at post-intervention; 2) *Low-High* group: This included participants whose HEI total scores were below the median baseline HEI total score at baseline and above the median baseline HEI total score post-intervention, indicating improved diet quality from pre- to post-intervention; 3) *High-Low* group: This included those whose HEI total score was above the median at baseline but dropped below the baseline median HEI total score at post-intervention, indicating these participants had healthy diet quality at baseline that worsened at post-intervention; 4) *High-High* group: This included participants whose scores were above the median baseline HEI total score at baseline and remained above the median baseline HEI total score at post-intervention, indicating these participants had high diet quality at baseline that remained healthy at post-intervention. Independent samples t-test and chi square analyses were conducted to examine differences between the *low* and *high* groups at baseline. Multinomial logistic regression was used to examine psychosocial predictors (anxiety, depression, fatalism) of status on pre- to post-intervention change in diet quality (*low-low*, *low-high*, *high-low*, and *high-high* groups).

In conducting the binomial and multinomial analyses to address Specific Aims 1 and 2, we controlled for age, sex, marital status, education level, employment status, financial comfort, BMI,

and health literacy, as these factors are known to influence dietary quality.<sup>12,43-47</sup> Because the majority of participants in this sample were non-Hispanic Whites (97%), reflective of the rural Kentucky population, race was not included in the models. All analyses were conducted in IBM SPSS, version 27.<sup>48</sup> An *a priori* alpha of 0.05 was used to determine statistical significance.

### 3.3 Results

#### 3.3.1 Sample

Characteristics of the sample are presented in Table 3.1. Of the 1143 original participants in the HeartHealth study, a total of 675 participants met inclusion criteria for this secondary analysis. The mean age of the overall sample was  $53 \pm 14.5$  years with the range of 21 to 90 years. Females comprised 75.4% of the sample and 71.3% were married or living with a partner (cohabitating). The sample was generally well educated, had adequate health literacy, and had enough financial resources to make ends meet. Compared to participants who were below the median HEI score at baseline, those who scored above the median were significantly older, were more likely to be female, were less likely to be employed, and were likely to have enough financial resources to make ends meet. No other significant between-group differences were noted.

#### 3.3.2 Binomial Logistic Regression of Baseline Groups

Using binomial logistic regression, we examined the psychosocial predictors (anxiety, depression, and fatalism) of group membership at baseline, controlling for age, sex, marital status, education level, employment status, financial comfort, BMI, and health literacy. The binomial logistic regression model was statistically significant,  $\chi^2(13) = 93.3$ ,  $p < 0.001$ , indicating the model better predicts categories of group membership as compared to the null model with no independent variables. The model correctly classified 17.2% of cases. Sensitivity was 66.6% and specificity was 65.9%. Of the three psychosocial predictors (anxiety, depression, and fatalism), only fatalism was found to be a significant predictor of group membership at baseline. For every 1-point increase in fatalism, there were 1.5 times greater odds of being in the *low* group compared to the *high* group

(OR=0.66, p=0.007); thus, those with higher fatalism were less likely to be in the *high* group at baseline. Results of the binomial logistic regression are presented in Table 3.2.

### 3.3.3 Multinomial Logistic Regression of Pre- to Post-Intervention Groups

Multinomial logistic regression was performed to assess anxiety, depression, and fatalism as predictors of membership in the *low-low*, *high-low*, and *high-high* groups with the *low-high* group as the reference category group. All three models contained three predictor variables (anxiety, depression, and fatalism) with eight covariates, including age, sex, marital status, education level, employment status, financial comfort, BMI, and health literacy. The overall model was significant ( $\chi^2[39] = 169.9, p < 0.001$ ). Results are presented below with the comparison to the *low-high* group as a referent, as this is the direction anticipated for participants' positive response to a healthy lifestyle intervention with a component focused on strategies to improve diet quality.

Of the three psychosocial predictors (anxiety, depression, and fatalism), anxiety and fatalism were significant predictors of post-intervention group membership. Compared to those in the *low-high* group, participants in the *low-low* group were more likely to have low anxiety (OR=1.71, p=0.03). Compared to those in the *low-high* group, those in the *high-high* group were more likely to have low anxiety (OR=1.61, p=0.03) and were less likely to have higher degrees of fatalism (OR=0.65, p=0.02). None of the three psychosocial factors significantly predicted membership in the *high-low* group compared to the *low-high* group. Results of the multinomial logistic regression are presented in Table 3.3.

### 3.3.4 Covariates

As shown in Tables 3.2 and 3.3, of the eight covariates included in the models, age, sex, socioeconomic status (employment status and financial comfort), and education level were consistently found to be significant predictors of diet quality at baseline and pre- to post-intervention. Individuals who were older, females, were unemployed, including those who were retired, and those who had enough to make ends meet were more likely to have high diet quality at baseline. Similarly, older participants and females were more likely to improve from low to high

diet quality at pre- and post-intervention compared to those who remained low at both times; females were also more likely to have high diet quality at both times. Higher levels of education and financial comfort were also predictive of better response to the intervention.

### 3.4 Discussion

#### 3.4.1 Predictors of Baseline Groups

At baseline, neither anxiety nor depression predicted diet quality, a finding inconsistent with other studies. For example, a study conducted by Gibson-Smith et al., in which associations between anxiety and depression and diet quality were examined in 1634 adults, the authors found that persons with an anxiety disorder or depression had significantly lower diet quality scores compared to adults with neither disorder as well as compared to those whose anxiety and depression were well controlled.<sup>19</sup> Similarly, in a recent study conducted by Keck et al. in which the role of anxiety and depression on diet quality was examined among college students in the southeastern U.S., it was found that as levels of anxiety and depression increased, consumption of sugar and saturated fat increased and fruits and vegetables decreased.<sup>49</sup> However, findings from studies that have focused specifically on examining the relationship between depression and diet quality have been mixed. For example, while several studies have demonstrated that higher levels of depressive symptoms are associated with poorer diet quality,<sup>49-52</sup> results from other studies suggest there is no relationship between depressive symptom severity and diet quality.<sup>20,53</sup> Moreover, results of some studies suggest a reverse relationship between depression and diet quality, in which diet quality influences the severity of depressive symptoms.<sup>20,54-56</sup> These contrasting findings indicate the need for future studies exploring the relationship between depressive symptom severity on diet quality in this population of adults.

Similar to depression, however, the results of some studies suggest a reverse relationship between anxiety and diet quality in which diet quality influences the severity of anxiety.<sup>56-58</sup> Diets that are high in fat, sugar, and processed foods have been associated with higher levels of anxiety.<sup>58</sup>

These contrasting findings and the limited evidence regarding the impact of anxiety on an individual's engagement with healthy lifestyle behaviors warrant future research examining the moderating effect of anxiety on diet quality and engagement with healthy lifestyle interventions.

Unlike anxiety and depression, fatalism was predictive of low diet quality at baseline. The findings from this study are consistent with what is known about the impact of fatalism on healthy lifestyle behaviors. In a study conducted by Walker et al., higher degrees of fatalism were found to have a negative impact on engagement with healthy lifestyle behaviors, such as medication adherence, physical activity, blood glucose monitoring, and diet.<sup>59</sup> Moreover, in a recent study conducted by San Diego and Merz exploring diabetes knowledge, fatalism, and type 2 diabetes preventive behaviors among college students, the authors reported that higher levels of fatalism were associated with poor diet quality, even when levels of diabetes knowledge were high, suggesting that feeling a lack of control over diabetes-related outcomes can override the benefits of high levels of diabetes knowledge on preventative health behaviors.<sup>60</sup>

#### 3.4.2 Predictors of Pre- to Post-Intervention Groups

In contrast to the findings from pre-intervention, although depressive symptoms did not predict change in diet quality from pre- to post-intervention, anxiety was predictive, with participants who scored low at pre- and post-intervention as well as those who scored high at both time points, having greater odds of low anxiety compared to those who improved from low to high diet quality. These findings are in contrast to research that has shown anxiety to have a negative impact on healthy lifestyle beliefs, which in turn impact engagement with healthy lifestyle behaviors among teens and adolescents.<sup>61</sup> Additionally, higher levels of anxiety have been associated with lower maternal diet quality among low-income mothers.<sup>62</sup> However, the findings of some researchers have demonstrated that a certain level of anxiety can serve to promote motivation and performance, thereby serving as an impetus to focus and take action.<sup>63,64</sup> This could be congruent with our findings that those whose diet quality improved from pre- to post-

intervention had higher anxiety than those whose diet quality did not change from pre- to post-intervention.

While higher fatalism predicted low diet quality in participants at baseline, it was also predictive of improvement from low pre-intervention to high post-intervention diet quality compared to those who had high diet quality at both time points. This finding that suggests that fatalism does not impact the effectiveness of a lifestyle intervention is supported by findings from previous studies.<sup>65</sup> This may be because the intervention was tailored to address difficult barriers to healthy diet that people in rural, low socioeconomic environments often face. For example, in response to the commonness of food deserts in rural communities,<sup>66</sup> the HeartHealth intervention integrated strategies such as teaching participants to purchase low sodium canned vegetables or, if not available, rinsing canned vegetables before consuming if fresh vegetables were unavailable for purchase or too expensive. This is supported by research indicating that the concept of “fatalism” is likely to be reflective of personal and societal appraisals of lack of opportunity to engage in health-promoting behaviors due to structural barriers.<sup>67,68</sup> Other investigators have shown that factors other than fatalism, including unclear communication about diet and information overload, have a more significant impact on diet quality in the context of diabetes and heart disease than does fatalism.<sup>69</sup> As a critical component of the HeartHealth intervention, clear communication strategies were used and information was presented in a socioculturally acceptable manner with the pace of the presentation set by participants.

### 3.4.3 Covariates

The covariate findings of this study are supported by research reporting older adults, women, and those with higher levels of education and socioeconomic status have higher quality diets.<sup>12,42-44</sup> Although a seemingly contradiction, the likelihood that those who were unemployed of having higher diet quality at baseline and pre- to post-intervention may be due to the fact that many who self-reported being unemployed were retired or on disability (unreported data) and may therefore have more time to shop for and prepare healthier food options. It may be beneficial,



therefore, to develop and test future interventions that address diet quality strategies tailored for those who work full- or part-time.

### 3.5 Limitations and Strengths

A limitation of this study is that 97% of respondents self-identified as being non-Hispanic White. This limits generalizability to more diverse populations; however, this is reflective of the rural Kentucky population. Of note, the HEI-2010 was used to measure participant diet quality, which was the current version at the time of the HeartHealth study; scores for the HEI-2010 do not vary significantly from those of the HEI-2015.<sup>70,71</sup> A strength of this study was the healthy lifestyle intervention upon which this study was leveraged; participants received socioculturally-tailored education that emphasized improving diet quality among other factors in order to reduce CVD risk. Many of these self-management strategies are similarly useful for reducing risk for other modifiable diseases, including type 2 diabetes. Also of importance, although participants were recruited from rural regions of Kentucky, many of the strategies incorporated into the HeartHealth intervention are applicable across rural communities with low socioeconomic and healthcare resources and who are burdened with similarly high rates of CVD and diabetes.

### 3.6 Conclusion

This study explored the psychosocial factors that contribute to diet quality among persons at risk for type 2 diabetes and CVD who engaged in a healthy lifestyle intervention that included a focus on improving dietary intake patterns. The findings of this study highlight the impact of fatalism among adults at risk for diabetes and CVD. These findings also contribute to what is known regarding the impact of psychosocial factors on diet quality and indicate a need for future studies examining the role of fatalism on diet quality. The results from the study can be used to guide interventions tailored to address the specific needs of populations at risk for developing chronic diseases, such as type 2 diabetes and CVD.

<b>Table 3.1.</b> Participant Characteristics at Baseline (Full sample and <i>Low</i> vs <i>High</i> group comparisons)				
	All Participants N = 675	Low n = 341	High n = 334	p-value*
	n (%) or mean $\pm$ SD			
Age				
18-30 years	40 (5.9%)	28 (8.2%)	12 (3.6%)	<b>&lt;0.001</b>
31- 50 years	247 (36.6%)	159 (46.6%)	88 (26.3%)	
$\geq$ 51years	388 (57.5%)	154 (45.2%)	234 (70.1%)	
Female	509 (75.4%)	235 (68.9%)	274 (82.0%)	<b>&lt;0.001</b>
White, non-Hispanic	653 (96.7%)	332 (97.4%)	321 (96.1%)	0.36
Married/cohabitating	481 (71.3%)	251 (73.6%)	230 (68.9%)	0.17
>High school education	430 (63.7%)	212 (62.2%)	218 (65.3%)	0.40
Employed	479 (71.0%)	274 (80.4%)	205 (61.4%)	<b>&lt;0.001</b>
Have enough	631 (93.5%)	311 (91.2%)	320 (95.8%)	<b>0.02</b>
Body mass index				
normal	99 (14.7%)	43 (12.6%)	56 (16.8%)	0.30
overweight	213 (31.6%)	112 (32.8%)	101 (30.2%)	
obese	363 (53.8%)	186 (54.5%)	177 (53.0%)	
Adequate health literacy	605 (89.6%)	307 (90.0%)	298 (89.2%)	0.73
Low anxiety	402 (59.6%)	191 (56.0%)	211 (63.0%)	0.06
Low depressive symptoms	577 (85.5%)	284 (83.3%)	293 (87.7%)	0.10
Fatalism	2.16 $\pm$ 0.57	2.22 $\pm$ 0.56	2.09 $\pm$ 0.58	<b>0.003</b>

\* reported for Chi square or independent samples t-test as appropriate.

<b>Table 3.2. Binomial Regression – Predictors of Belonging to <i>High</i> Group at Baseline (N=675)</b>				
	Odds Ratio	95% Confidence Interval		p-value
		Lower	Upper	
Age (18-30 years, ref)				
31-50 years	1.49	0.69	3.19	0.31
≥51 years	3.16	1.50	6.67	<b>0.003</b>
Female	2.26	1.52	3.36	<b>&lt;0.001</b>
Married/Cohabiting	0.84	0.57	1.22	0.36
>High school education	1.31	0.91	1.88	0.14
Employed	0.48	0.32	0.71	<b>&lt;0.001</b>
Have enough to make ends meet	2.12	1.06	4.25	<b>0.03</b>
Adequate health literacy	1.05	0.60	1.82	0.87
Body mass index (normal, ref)				
overweight	0.70	0.42	1.18	0.18
obese	0.84	0.52	1.37	0.49
Low anxiety	1.25	0.87	1.80	0.23
Low depressive symptoms	1.03	0.62	1.70	0.92
Fatalism	0.66	0.50	0.90	<b>0.01</b>

**Table 3.3.** Multinomial Regression – Comparing Participants who Scored Above and Below Baseline Median HEI Total Score Pre- and Post-Intervention\* (N=675)

*Reference category = <i>Low-High</i> (n=172)		Odds Ratio	95% Confidence Interval		p-value
			Lower	Upper	
Low-Low (n=169)	Age (18-30 years, ref)				
	31-50 years	0.62	0.25	1.53	0.30
	≥51 years	0.29	0.11	0.72	<b>0.01</b>
	Female	0.56	0.34	0.93	<b>0.02</b>
	Married/Cohabiting	0.65	0.38	1.10	0.11
	>High school education	0.44	0.27	0.71	<b>0.001</b>
	Employed	0.93	0.50	1.72	0.81
	Have enough	1.96	0.86	4.45	0.11
	Adequate health literacy	1.42	0.66	3.02	0.37
	Body mass index (normal, ref)				
	overweight	0.53	0.25	1.12	0.09
	obese	0.47	0.23	0.96	<b>0.04</b>
Low anxiety	1.71	1.05	2.80	<b>0.03</b>	
Low depressive symptoms	0.81	0.42	1.55	0.52	
Fatalism	0.97	0.64	1.46	0.87	
High-Low (n=39)	Age (18-30 years, ref)				
	31-50 years	0.61	0.15	2.46	0.48
	≥51 years	0.20	0.05	0.83	<b>0.03</b>
	Female	1.63	0.63	4.19	0.31
	Married/Cohabiting	1.27	0.50	3.23	0.61
	>High school education	0.39	0.18	0.86	<b>0.02</b>
	Employed	0.17	0.07	0.41	<b>&lt;0.001</b>
	Have enough	1.51	0.43	5.34	0.52
	Adequate health literacy	0.84	0.28	2.46	0.74
	Body mass index (normal, ref)				
	overweight	0.54	0.16	1.82	0.32
	obese	0.60	0.19	1.87	0.38
Low anxiety	1.42	0.62	3.24	0.41	
Low depressive symptoms	0.54	0.20	1.43	0.21	
Fatalism	0.61	0.31	1.20	0.15	
High-High (n=295)	Age (18-30 years, ref)				
	31-50 years	1.38	0.48	3.91	0.55
	≥51 years	2.49	0.89	6.94	0.08
	Female	1.69	1.03	2.75	<b>0.04</b>
	Married/Cohabiting	0.61	0.38	0.98	<b>0.04</b>
	>High school education	0.99	0.63	1.56	0.97
	Employed	0.54	0.33	0.89	<b>0.02</b>
	Have enough	3.48	1.52	7.98	<b>0.003</b>
	Adequate health literacy	1.36	0.69	2.66	0.38
	Body mass index (normal, ref)				
	overweight	0.52	0.27	1.01	0.05
	obese	0.58	0.31	1.10	0.09
Low anxiety	1.61	1.04	2.49	<b>0.03</b>	
Low depressive symptoms	1.09	0.59	2.00	0.79	
Fatalism	0.65	0.45	0.95	<b>0.02</b>	

## CHAPTER 4. IMPACT OF COVID-19 ON TYPE 2 DIABETES SELF-MANAGEMENT AND DISTRESS

### 4.1 Introduction

Approximately 34 million adults aged 18 years or older in the United States have diabetes, accounting for 13% of the U.S. adult population.<sup>1</sup> An estimated 90 to 95% of individuals with diabetes have type 2 diabetes.<sup>2</sup> Diabetes increases an individual's risk for complications such as cardiovascular disease, kidney disease, neuropathy, retinopathy, infections, and skin impairments such as ulcerations.<sup>3</sup> Risk factors for diabetes-related complications include being overweight or obese, physical inactivity, hypertension, high cholesterol, and uncontrolled blood glucose levels indicated by a hemoglobin A1C higher than 9%.<sup>1</sup>

The American Diabetes Association recommends all adults with type 2 diabetes participate in healthy lifestyle programs, such as Diabetes Self-Management Education and Support (DSMES), to learn lifestyle modification strategies that can foster individuals' diabetes self-management.<sup>4</sup> Referral to the DSMES program is based on four critical time points: at diagnosis, annually, when disease-related complications arise that impact an individual's ability to self-manage their diabetes, and when transitions in care occur.<sup>5-7</sup> The program is delivered by a trained healthcare professional (i.e., registered nurse, registered dietician/nutritionist, or pharmacist) across a variety of virtual and in-person settings including hospital outpatient departments, rural health clinics, community centers, worksites, and medical homes.<sup>8,9</sup> Attendance of the DSMES is intended to support healthy coping skills as well as engagement in diabetes self-management behaviors and has demonstrated improvements in A1C by 0.6% among those who engage with the program; however, these improvements are associated with >10 hours of program attendance.<sup>5,10</sup> Despite the breadth of evidence supporting the effectiveness of the DSMES program, few individuals with type 2 diabetes receive self-management education through DSMES, with only 6.8% of newly

diagnosed individuals receiving DSMES education within the first year of diagnosis and less than 5% of Medicare recipients utilizing the program.<sup>5,7</sup>

Engagement in self-management behaviors can lead to improved diabetes outcomes as well as prevent or delay complications associated with diabetes.<sup>11-14</sup> The Association of Diabetes Care and Education Specialists (formerly the American Association of Diabetes Educators) has identified 7 essential self-management behaviors, the ADCES 7 Self-Care Behaviors<sup>®</sup>: healthy coping, healthy eating, being active, monitoring, taking medication, reducing risks, and problem solving.<sup>10,12</sup> Healthy coping was previously listed at the end of the 7 self-management behaviors; however, recently, the ADCES 7 Self-Care Behaviors<sup>®</sup> were revised to place “healthy coping” at the forefront of the 7 self-management behaviors, as this behavior has been determined to be a critical component for mastering the other behaviors.<sup>10</sup>

Coronavirus Disease-2019 (COVID-19) is a highly infectious novel respiratory disease caused by the severe acute respiratory syndrome-coronavirus 2 (SARS-CoV-2) and is primarily spread via droplets or direct physical contact with infected persons or surfaces.<sup>15-18</sup> Symptoms range in severity from mild flu-like symptoms, such as fever, chills, dry cough, fatigue, muscle aches or pain, sore throat, congestion, headache, and new loss of taste and smell, to severe respiratory distress or failure, and death.<sup>15,17</sup> While general recommendations for preventative measures throughout the COVID-19 pandemic have included frequent and thorough handwashing, wearing of face masks, covering the mouth and nose when coughing, and avoiding touching of the face, the most restrictive protective measures included maintaining social distance from others to prevent the contraction or spread of the disease.<sup>15,18-20</sup> As well as increasing a sense of social isolation due to the social distancing mandates, mandatory stay-at-home orders reduced opportunities to engage in physical activity for many. As well, shorter store hours, long wait lines, and reduced availability of both food and needed medical supplies all presented significant barriers to accessing items needed for self-management.<sup>21,22</sup> Further, those with underlying pre-existing chronic illnesses, including diabetes, have been disproportionately affected by the virus, leading to significantly

higher rates of COVID-19-related morbidity and mortality, therefore adherence to social distancing recommendations to reduce risk of contracting the disease was particularly critical for these individuals.<sup>17,23,24</sup>

While social distancing, enforced through stay-at-home orders and quarantine measures, was among the most effective strategies for reducing the spread of COVID-19 throughout the pandemic, it also had the potential to create significant barriers to diabetes self-management and to exacerbate diabetes distress. For example, studies have shown that social distance mandates increased an already existing sense of social isolation among many in the United States.<sup>25</sup> Social isolation is characterized by reduced or infrequent social contact, living alone, and low perceived social support<sup>26</sup> and has been shown to increase diabetes distress as well as decreased self-management, contributing to negative health outcomes.<sup>26-28</sup> Social support and frequent contact with family, friends, and peers have been found to improve emotional well-being and engagement in diabetes self-management behaviors.<sup>27,29,30</sup>

Individuals with diabetes are at increased risk for experiencing diabetes distress, a psychological state characterized by anxiety, depression, frustration, and worry about diabetes-related health outcomes, access to care, and support.<sup>31,32</sup> Diabetes distress occurs when an individual becomes emotionally burdened by the demands of managing their diabetes and can lead to the reduced ability to engage in self-management behaviors.<sup>10,31,32</sup> The combined effects of social isolation and the multiple barriers presented by social restrictions, as well as the worries about contracting the virus, have led to concerns about increased rates of diabetes distress.<sup>33</sup>

Research examining the impact of restrictions related to COVID-19 on diabetes self-management and diabetes distress individuals with type 2 diabetes is limited. Therefore, the purpose of this cross-sectional study was to examine the impact of restrictions related to COVID-19 on type 2 diabetes self-management behaviors as described by the ADCES 7 Self-Care Behaviors<sup>®</sup> and to examine whether restrictions impacted self-management behaviors and diabetes distress. Because the purpose of the DSMES classes is to support self-management and reduce

diabetes distress, we were also interested in examining if attendance at one or more DSMES classes impacted self-management during the pandemic. The specific aims of this study were to:

- 1) examine whether COVID-19 impact and attendance of at least one DSMES class were predictive of type 2 diabetes self-management during the pandemic, including self-management adherence, ease, coping, importance, and overall self-management profile, controlling for age, sex, financial status, marital status, and diabetes duration; and
- 2) examine whether COVID-19 impact and attendance of at least one DSMES class were predictive of diabetes distress in individuals with type 2 diabetes, including emotional burden, regimen distress, interpersonal distress, and overall diabetes distress, controlling for age, sex, financial status, marital status, and diabetes duration.

## 4.2 Methods

### 4.2.1 Design and Sample

We conducted a cross-sectional study examining the impact of the COVID-19 pandemic on diabetes self-management practices and diabetes distress among individuals with type 2 diabetes. Participants were recruited from the University of Kentucky Healthcare Barnstable Brown Diabetes Center using purposive sampling. Inclusion criteria were adults with type 2 diabetes who were 18 years of age or older, had a working email address located in the healthcare system's electronic medical records, and had access to a computer or other electronic device compatible with the survey system. Exclusion criteria included diagnosed cognitive disorders documented in the electronic medical record, such as dementia, that could prevent individuals from providing informed consent.

### 4.2.2 Procedures

Approval for this study was obtained from the University of Kentucky's Institutional Review Board prior to enrolling subjects. Potential participants were identified through electronic medical chart review. Eligible participants were sent an emailed invitation containing information



about the study and a link to access the online consent form. Once informed consent was obtained, participants were redirected to the online survey, which contained sociodemographic and clinical history items. Four questionnaires were used to measure the impact of the COVID-19 pandemic on their daily life, perceived social support, diabetes distress, and diabetes self-management practices prior to and after the emergence of the COVID-19 pandemic. The online survey was housed on the secure, web-based Research Electronic Data Capture (REDCap)<sup>®</sup> platform.<sup>34</sup> Upon completion of the survey and collection of clinical data, participants received a \$10 electronic gift certificate as compensation for their time.

#### 4.2.3 Measures

##### 4.2.3.1 Sociodemographic Information

Participants provided self-reported sociodemographic and clinical information. This included age in years and sex (male or female). Participants were asked to self-report race and ethnicity. As the majority of participants were non-Hispanic White, we dichotomized race and ethnicity as “non-Hispanic White” and “other racial and ethnic groups”. Marital status was dichotomized as “married/cohabitating” indicating participants who reported being married or living with a partner (cohabitating) and “single, widowed, divorced”. Education was dichotomized into “high school or less” and “some college or more” based on participant self-report. Participants were asked about employment status, and responses were dichotomized into “employed” and “not employed”. To measure financial status, participants were asked to indicate whether they had more than enough to make ends meet, enough to make ends meet, or did not have enough to make ends meet. Financial status was dichotomized as “have enough”, which included participants who self-identified as having enough money or income to make ends meet each month and “not enough”, which included those who indicated they do not have enough to make ends meet each month. Diabetes duration was dichotomized into those who had been diagnosed with diabetes for five years or less and those who had been diagnosed for more than five years, a commonly used cut point for group comparisons among individuals with diabetes.<sup>35-37</sup> Attendance at the DSMES program was

dichotomized to compare those who had attended at least one class of the DSMES program to those who had not.

#### 4.2.3.2 Coronavirus Impact Scale

The Coronavirus Impact Scale was used to assess how COVID-19 impacted participants' daily life. Using a 4-point Likert scale ranging from 0 (none/no change) to 3 (severe), this 12-item questionnaire asks individuals about changes to daily routines as a result of the COVID-19 pandemic; effect of the pandemic on family income and employment; interference with access to food, medical care, mental health resources, and social support persons; experiences of stress related to the pandemic; and whether the individual or their family has experienced symptoms or been diagnosed with COVID-19.<sup>38</sup> The COVID-19 impact score is a sum of the first eight items and ranges from 0 to 24 with higher scores indicating greater impact as a result of the COVID-19 pandemic.<sup>38,39</sup> Reliability studies for the Coronavirus Impact Scale achieved Cronbach's alphas ranging from 0.71 to 0.81; in this sample of individuals with type 2 diabetes, the Cronbach's alpha was 0.70, indicating good internal consistency.<sup>39</sup>

#### 4.2.3.3 Self-Management Profile for Type 2 Diabetes

Diabetes self-management behaviors were assessed using the Self-Management Profile for Type 2 Diabetes (SMP-T2D) questionnaire. This validated 12-item questionnaire includes questions about an individual's self-management behaviors following the ADCES 7 Self-Care Behaviors<sup>®</sup> framework.<sup>14</sup> Scoring for the SMP-T2D is such that higher scores indicate better self-management. The SMP-T2D was validated in two clinical trials with Cronbach's alphas ranging from 0.71 to 0.87 as a measure of internal consistency.<sup>14</sup> For the purposes of this study, we developed a total score and four subscale scores measuring self-management adherence, ease, coping, and importance. Subscale scores were calculated to determine self-management measures including adherence, ease, coping, importance, and overall self-management profile. Self-management adherence subscale scores range from 0 to 49, with higher scores indicating better adherence; a Cronbach's alpha of 0.73 was achieved for this sample. Self-management ease scores

range from 8 to 32, with higher scores indicating greater self-management ease. For this sample, a Cronbach's alpha of 0.87 was achieved for the ease subscale. Coping scores range from 3 to 15, with higher scores indicating higher levels of coping. A Cronbach's alpha of 0.85 was achieved for coping in this sample. Importance of self-management scores range from 6 to 30, with higher scores indicating greater importance; a Cronbach's alpha of 0.85 was achieved for this sample. Overall self-management scores range from 17 to 126 with higher scores indicating better overall self-management. For overall self-management, a Cronbach's alpha of 0.86 was achieved for this sample.

#### 4.2.3.4 Diabetes Distress Scale

Diabetes distress was measured using the Diabetes Distress Scale. This 17-item instrument for measuring diabetes-related emotional distress has been validated for both research and clinical use.<sup>31,32,40</sup> Responses for the Diabetes Distress Scale are based on a 6-point Likert scale with responses ranging from 1 (not a problem) to 6 (a very serious problem). A mean score is developed to measure overall diabetes distress, with mean scores  $\geq 3$  indicating high levels of distress.<sup>31,40</sup> Scores for diabetes distress subscales and overall distress score range from 1 to 6 with higher scores indicating higher levels of distress for those areas.<sup>31,40</sup> Subscales for the Diabetes Distress Scale measure distress related to emotional burden (5 items), regimen (5 items), interpersonal (3 items), and physician-related distress (4 items) with Cronbach's alphas greater than 0.87 for the subscales and overall distress.<sup>31</sup> For the purposes of this study we examined emotional burden, regimen, interpersonal distress, and overall distress; Cronbach's alphas for each of these scales were 0.77, 0.93, 0.70, and 0.94, respectively.

#### 4.2.4 Data Analysis

All analyses were conducted using SPSS, v.27. Descriptive statistics, including t-tests and chi square, were used to characterize the sample and to assess differences between those who had attended at least one DSMES class to those who had not. For Specific Aim 1, we conducted multiple linear regression to examine whether the impact of COVID-19 and DSMES program attendance

were predictive of type 2 diabetes self-management adherence, ease, burden, importance, and overall self-management during the pandemic. For Specific Aim 2, we conducted a multiple linear regression to examine whether the impact of COVID-19 and attendance of one or more DSMES classes were predictive of emotional burden, regimen distress, interpersonal distress, and overall diabetes distress in individuals with type 2 diabetes. For each model, we controlled for age, sex, marital status, financial status, and length of diabetes diagnosis, as these factors have shown to have an impact on self-management adherence and diabetes-related distress.<sup>41-43</sup> As the majority of the sample self-identified as non-Hispanic White (89.7%), race and ethnicity were not included in the analyses.

## 4.3 Results

### 4.3.1 Sample

We recruited 99 individuals to participate in this study. Of these 99 individuals, three individuals accessed the consent form but declined to participate in the survey, three participants completed the survey twice, and seven had missing data on key variables of interest and were therefore excluded from the analyses. Thus, a total sample of 86 participants was included in this study. Characteristics of the sample are presented in Table 4.1. Participants ranged in age from 33 to 83 years ( $57 \pm 12.28$  years) and were predominantly female (50.6%). The majority of participants in this sample were married or cohabitating (69.0%) and reported having some college education or more (90.8%). There were no significant differences in sociodemographic or clinical variables of interest between those who had attended at least one DSMES class compared to those who had not, with the exception of diabetes duration, in which those who had diagnosed diabetes >5 years were less likely to have attended at least one DSMES class.

### 4.3.2 Predictors of Self-Management

The model for the self-management adherence subscale was significant ( $F [7,78], 3.16, p = 0.005$ ) with an  $R^2$  of 0.22 (Table 4.2). Impact of COVID-19 significantly predicted self-

management adherence with a 1-point increase in COVID-19 impact leading to a 0.91-point decrease in self-management adherence (95% CI, -1.52 to -0.29,  $p=0.004$ ).

The model for self-management ease was significant ( $F [7,78], 3.72, p=0.002$ ) with an  $R^2$  of 0.25. Impact of COVID-19 significantly predicted self-management ease with a 1-point increase in COVID-19 impact leading to a 0.65-point increase in self-management ease (95% CI, 0.21 to 1.09,  $p=0.004$ ).

The model for self-management coping was significant ( $F [7,78], 4.65, p<0.001$ ) and accounted for 29.4% of the variation in coping. Impact of COVID-19 significantly predicted coping with a 1-point increase in COVID-19 impact leading to a 1.12-point decrease in coping (95% CI, -1.60 to -0.63,  $p<0.001$ ).

The model for self-management importance was significant ( $F [7,78], 2.91, p = 0.009$ ) with an  $R^2$  of 0.21. Neither COVID-19 impact nor DSMES program attendance significantly predicted self-management importance; however, the covariates sex and diabetes duration did significantly predict self-management importance.

The model for overall self-management was significant ( $F [7,78], 4.93, p<0.001$ ) and accounted for 30.7% of the variation in overall self-management. Impact of COVID-19 significantly predicted overall self-management with a 1-point increase in COVID-19 impact leading to a 13.71-point decrease in overall self-management (95% CI, -20.64 to -6.79,  $p<0.001$ ).

#### 4.3.3 Predictors of Diabetes Distress

The model for diabetes distress related to emotional burden was significant ( $F [7,78], 5.98, p<0.001$ ) with an  $R^2$  of 0.35 (Table 4.3). Impact of COVID-19 significantly predicted emotional burden with every 1-point increase in score on the COVID-19 impact scale predicting a nearly 1-point increase in emotional burden (95% CI, 0.57 to 1.35,  $p<0.001$ ).

The model for diabetes distress related to diabetes distress caused by regimen was significant ( $F [7,78], 6.72, p<0.001$ ) and accounted for 37.6% of the variation in distress related to regimen. Impact of COVID-19 significantly predicted diabetes distress related to self-management

regimen with a 1-point increase in COVID-19 impact leading to a 1.64-point increase in regimen distress (95% CI, 1.05 to 2.23,  $p < 0.001$ ).

The model for interpersonal distress was significant ( $F [7,78], 6.38, p < 0.001$ ) and accounted for 36.4% of the variation in interpersonal distress. Both COVID-19 impact and DSMES program attendance significantly predicted interpersonal distress. Those who had attended at least one DSMES class had a 0.41-point decrease in interpersonal distress ( $p = 0.038$ ) compared to those who had not attended at least one DSMES class. At the same time, for every 1-point increase in COVID-19 impact, there was a 1.04-point increase in interpersonal distress (95% CI, 0.62 to 1.46,  $p < 0.001$ ).

The model for overall diabetes distress was significant ( $F [7,78], 7.37, p < 0.001$ ) and accounted for 39.8% of the variation in overall distress. Impact of COVID-19 significantly predicted overall diabetes distress with a 1-point increase COVID-19 impact leading to a 1.19 increase in overall diabetes distress (95% CI, 0.78 to 1.61,  $p < 0.001$ ).

#### 4.3.4 Covariates

As shown in Table 4.2, of the five covariates included in the models, sex and diabetes duration were found to be significant predictors of diabetes self-management during the COVID-19 pandemic. Sex was a significant predictor of diabetes self-management ease, self-management importance, and overall self-management. While females scored higher on the subscale for self-management ease, they scored lower for the self-management importance subscale and for overall self-management when compared to males. Individuals who had been diagnosed with diabetes  $\leq 5$  years scored lower for self-management adherence and overall self-management.

As shown in Table 4.3, of the five covariates included in the model, age was a significant predictor of diabetes distress during the COVID-19 pandemic. Age was a significant predictor of emotional burden related to diabetes distress; however, these findings were not clinically significant with emotional burden related to diabetes distress decreasing by 0.1 points with every five-year increase in age.

## 4.4 Discussion

### 4.4.1 COVID-19 Impact as a Predictor of Diabetes Self-Management and Distress

Findings from this study indicated that greater impact of COVID-19 on participants' lives predicted poorer self-management and increased diabetes distress. These findings are consistent with results from studies that suggest that poor self-management was exacerbated during the COVID-19 pandemic.<sup>44-46</sup> This was, in part, due to the need to control the spread of COVID-19 through intermittent social distancing measures. While social restrictions were beneficial in reducing the spread of COVID-19, these restrictions created significant barriers to accessing self-management resources for individuals with diabetes, such as reduced access to options for maintaining physical activity, to healthy food supplies, and to healthcare providers and medications.<sup>44,45,47,48</sup>

It is understandable that, while decreasing self-management adherence, coping, and overall self-management, the impact of COVID-19 was not associated with patients' understanding of the importance of diabetes self-management. Changes in self-management associated with COVID-19 impact are more likely attributed to barriers to self-management resources, which may underscore the importance of maintaining self-management behaviors among individuals with diabetes. Additionally, in a qualitative study conducted by Grabowski et al. that examined self-management routines and adaptation during the COVID-19 pandemic, participants reported taking steps to reduce their risk for COVID-19 exposure through maintaining self-management behaviors, such as engaging in physical activity and maintaining a healthy diet.<sup>21</sup> Thus, awareness that individuals with type 2 diabetes are at increased risk for contracting COVID-19 may contribute to the continued perceived importance of diabetes self-management as a strategy to reduce COVID-19 exposure risk; however, future qualitative studies examining the importance of diabetes self-management during the COVID-19 pandemic are needed to better understand this phenomenon.

Perhaps of greater interest was the finding that increasing COVID-19 impact was associated with greater self-management ease. Grabowski et al. similarly found that disruptions to

self-management routines were primarily associated with how impactful COVID-19 lockdown restrictions were to participants' daily lives.<sup>21</sup> Those participants who experienced greater disruption to daily life due to lockdown restrictions reported greater disruptions to diabetes self-management routines, while those who were largely unaffected by lockdown restrictions reported being able to maintain pre-pandemic diabetes management routines.<sup>21</sup> However, additional research exploring patients' perceptions of self-management ease during the pandemic is needed to shed greater insight into this association.

While greater impact due to COVID-19 contributed to worse diabetes self-management, it also contributed to higher diabetes distress. This is unsurprising, given that diabetes self-management has been found to be negatively impacted by diabetes distress.<sup>37,49</sup> A myriad of factors surrounding the pandemic were likely to have contributed to diabetes distress. For example, research has demonstrated that social isolation has been associated with increased psychological distress.<sup>50</sup> Moreover, while research on the impact of the COVID-19 pandemic regarding diabetes distress is limited, research examining psychological distress amid the COVID-19 pandemic has demonstrated increased rates of depression, anxiety, and reports of loneliness among U.S. adults.<sup>50,51</sup> Compounding this, individuals with diabetes are at increased risk for mental health issues.<sup>48</sup> The findings of the present study in combination with what is known about psychological distress among individuals with type 2 diabetes highlight the need for greater access to mental health resources during times of crises and the need for interventions aimed at improving psychological distress among this population, particularly when access to resources is limited.

#### 4.4.2 DSMES as a Predictor of Diabetes Self-Management and Distress

Interestingly, DSMES attendance was not found to be a significant predictor of self-management adherence, ease, coping, importance, or overall self-management; however, DSMES program attendance was a significant predictor of interpersonal distress but did not significantly predict distress related to emotional burden, regimen, or overall distress. In contrast to the results of this study, previous findings have demonstrated that attending the DSMES program promotes



better self-management and reduces diabetes-related distress; however, during the COVID-19 pandemic, resources were limited, including access to DSMES services. Additionally, a study conducted by Sperl-Hillen et al. demonstrated that, while benefits of individually-received diabetes self-management education resulted in sustained improvements in diabetes distress, improvements in individual self-management behaviors, such as physical activity and diet, were not sustained, indicating the need for continued reinforcement of the self-management strategies addressed in the program.<sup>52</sup> This highlights the need for future interventions based on the DSMES program that incorporate ongoing diabetes self-management education and support for individuals with diabetes.

DSMES program attendance significantly predicted decreased interpersonal distress during the COVID-19 pandemic. Given that assessment of social support is a critical component of the DSMES program, this finding supports the importance of this aspect of the program.<sup>5</sup> Further, the ADCES 7<sup>®</sup> Self-Care Behaviors were recently revised to place healthy coping at the forefront of the seven behaviors as healthy coping is critical for the mastery of the other self-management behaviors.<sup>10</sup> The DSMES program fosters healthy coping skills among individuals with diabetes in order to reduce the burden of psychosocial factors that interfere with an individual's psychological well-being and provides strategies for coping with the constant demands associated with diabetes self-management that may contribute to diabetes distress.<sup>10</sup> The findings of this study indicate that the social support component of the DSMES program may contribute to increased awareness of and access to social support systems that may lead to reduced interpersonal distress during times when resources are limited; however, additional research is needed to examine the direct association between the DSMES program and its effect on diabetes distress.

#### 4.4.3 Covariates

The covariate findings of this study are supported by previous research. In a study examining factors associated with diabetes distress among 267 adults with type 2 diabetes, Wardian and Sun similarly found that older age was a predictor of lower diabetes distress.<sup>53</sup> The differences found between males and females in self-management ease, importance, and overall self-

management may be due to differences in male and female approaches to self-management. For example, a qualitative study conducted by Mathew et al. found that males tended to focus self-management efforts on reducing or eliminating intake of foods they perceived to be unhealthy, whereas women focused self-management efforts on social resources such as attending educational classes and support groups.<sup>54</sup> Utilization of social support resources has been associated with greater self-management capabilities.<sup>55</sup>

The finding that those who had attended at least one DSMES were more likely to have been diagnosed with diabetes  $\leq 5$  years is not unexpected. This is because individuals with a shorter diabetes diagnosis duration are more likely to have had a provider referral, as providers are becoming increasingly aware of the importance of this program.<sup>56-58</sup> Diabetes duration was a significant predictor of self-management adherence, importance, and overall self-management. Those who had been diagnosed with diabetes for five years or less scored higher on self-management adherence and importance when compared to those who had been diagnosed with diabetes for more than five years. These findings are supported in a study conducted by Ho et al., which found that individuals with diagnosed diabetes less than one year were more likely to engage in healthy lifestyle behaviors than those with diagnosed diabetes more than three years.<sup>59</sup> This may be due to better adherence to self-management recommendations as a result of greater perceived importance of self-management among those who are newly diagnosed; however, individuals who had been diagnosed with diabetes for five years or less scored lower on overall self-management when compared to those who had been diagnosed for more than five years. This may be a result of those with diagnosed diabetes greater than five years having developed their own self-management strategies that were beneficial even during a global crisis.

#### 4.5 Implications

Due to individuals with diabetes being disproportionately affected by COVID-19 and the potential for measures aimed at reducing the transmission of COVID-19 to have a negative impact

on type 2 diabetes self-management practices, specific recommendations for individuals with diabetes are needed to prevent complications associated with diabetes during times of crises.<sup>60</sup> The findings from this study highlight the impact of the COVID-19 pandemic on diabetes self-management and diabetes distress, indicating the need for interventions that prepare individuals with chronic diseases, such as type 2 diabetes, for future emergencies. Further, interventions are needed that provide individuals with the skills and strategies to self-manage their diabetes should future crises that further diminish access to resources arise, such as global pandemics or severe weather events.<sup>21</sup> Additionally, considering age significantly predicted emotional burden related to diabetes distress, and sex and diabetes duration were significant predictors of self-management, future interventions should take into account the specific needs of older adults, differences in self-management needs between males and females, and length of time since diabetes diagnosis when providing strategies to improve diabetes self-management and psychosocial outcomes during times of crises.

#### 4.6 Limitations and Strengths

For the current study, we did not collect data on the impact of the number of minutes DSMES program attendance had on self-management and diabetes distress. Future studies should examine dose response to better understand this relationship. Despite this, the current study provides a novel examination of the impact of the DSMES program attendance on diabetes self-management and distress during the COVID-19 pandemic, of which current research is limited.

#### 4.7 Conclusion

Although we are now in the resolution phase of the COVID-19 pandemic, findings from this study suggest the importance of understanding the impact of the pandemic on self-management and diabetes distress among patients with type 2 diabetes. Higher reported impact of the COVID-19 pandemic was associated with higher diabetes distress and poorer self-management overall,

indicating a need for interventions aimed at improving self-management strategies during times of crisis. The results from this study can be used to guide future interventions aimed at improving self-management strategies among individuals with type 2 diabetes when supportive resources are limited.

<b>Table 4.1. Sample Characteristics Based on DSMES Attendance*</b>				
	<b>All (N=87)</b>	<b>Attended DSMES (n=29)</b>	<b>Have not attended DSMES (n=58)</b>	<b>p-value</b>
	<b>n (%) or mean <math>\pm</math> SD</b>			
Age (years)	57.0 $\pm$ 12.3	55.5 $\pm$ 11.9	57.8 $\pm$ 12.5	0.46
Sex, female <sup>a</sup>	44 (50.6%)	13 (44.8%)	31 (53.4%)	0.45
Race, White	78 (89.7%)	26 (89.7%)	52 (89.7%)	0.49
Marital status, not married/cohabitating <sup>a</sup>	27 (31.0%)	7 (24.1%)	20 (35.5%)	0.33
Education, some college or more	79 (90.8%)	27 (93.1%)	52 (89.7%)	0.60
Employment, employed	47 (54.0%)	19 (65.5%)	28 (48.3%)	0.13
Financial comfort, not enough <sup>a</sup>	13 (14.9%)	5 (17.2%)	8 (13.8%)	0.67
Diabetes duration, $\leq$ 5 years <sup>a</sup>	25 (28.7%)	13 (44.8%)	12 (20.7%)	<b>0.02</b>

\*Data for 86 participants included in linear regression analyses

a = denotes comparison group for subsequent analyses

<b>Table 4.2. Results of Linear Regression – Predictors of Self-Management (N=86)</b>						
				<b>95% CI</b>		
<b>Subscale</b>	<b>Variable</b>	<b>B</b>	<b><math>\beta</math></b>	<b>Lower</b>	<b>Upper</b>	<b>p-value</b>
Adherence	Age, years	0.01	0.09	-0.01	0.03	0.39
	Female	-0.46	-0.18	-1.05	0.12	0.12
	Not married/cohabitating	-0.31	-0.11	-0.92	0.31	0.32
	Financial comfort, not enough	0.38	0.11	-0.42	1.18	0.35
	Diabetes $\leq 5$ years	-0.69	-0.24	-1.30	-0.09	<b>0.03</b>
	Have not attended DSMES	-0.09	-0.03	-0.66	0.47	0.74
	Coronavirus Impact	-0.91	-0.33	-1.52	-0.29	<b>0.004</b>
	Overall R <sup>2</sup> = 0.22					
Ease	Age, years	-0.01	-0.15	-0.03	0.01	0.16
	Female	0.47	0.25	0.06	0.89	<b>0.03</b>
	Not married/cohabitating	0.01	0.004	-0.43	0.45	0.97
	Financial comfort, not enough	-0.06	-0.02	-0.63	0.51	0.84
	Diabetes $\leq 5$ years	0.29	0.14	-0.14	0.72	0.18
	Have not attended DSMES	-0.03	-0.02	-0.44	0.38	0.88
	Coronavirus Impact	0.65	0.22	0.21	1.09	<b>0.004</b>
	Overall R <sup>2</sup> = 0.25					
Coping	Age, years	0.01	0.08	-0.01	0.03	0.44
	Female	-0.31	-0.14	-0.77	0.15	0.19
	Not married/cohabitating	0.02	0.01	-0.47	0.49	0.95
	Financial comfort, not enough	0.19	0.06	-0.44	0.82	0.55
	Diabetes $\leq 5$ years	-0.29	-0.13	-0.77	0.18	0.22
	Have not attended DSMES	-0.09	-0.04	-0.54	0.35	0.68
	Coronavirus Impact	-1.12	-0.49	-1.60	-0.63	<b>&lt;0.001</b>
	Overall R <sup>2</sup> = 0.29					
Importance	Age, years	0.04	0.12	-0.04	0.12	0.30
	Female	-2.91	-0.33	-4.94	-0.88	<b>0.005</b>
	Not married/cohabitating	1.09	0.11	-1.04	3.22	0.31
	Financial comfort, not enough	-0.44	-0.04	-3.21	2.34	0.76
	Diabetes $\leq 5$ years	2.29	0.23	0.18	4.39	<b>0.03</b>
	Have not attended DSMES	0.27	0.03	-1.70	2.25	0.79
	Coronavirus Impact	-0.01	-	-2.16	2.13	0.99
	Overall R <sup>2</sup> = 0.21					
Overall Self-Management	Age, years	0.16	0.13	-0.10	0.42	0.23
	Female	-6.77	-0.22	-13.33	-0.22	<b>0.04</b>
	Not married/cohabitating	-2.17	-0.06	-9.06	4.73	0.53
	Financial comfort, not enough	3.58	0.08	-5.39	12.56	0.43
	Diabetes $\leq 5$ years	-7.58	-0.22	-14.38	-0.78	<b>0.03</b>
	Have not attended DSMES	-0.89	-0.03	-7.27	5.49	0.78
	Coronavirus Impact	-	-	-20.64	-6.79	<b>&lt;0.001</b>
	Overall R <sup>2</sup> = 0.31					

<b>Table 4.3. Results of Linear Regression – Predictors of Diabetes Distress (N=86)</b>						
				<b>95% CI</b>		
<b>Subscale</b>	<b>Variable</b>	<b>B</b>	<b><math>\beta</math></b>	<b>Lower</b>	<b>Upper</b>	<b>p-value</b>
Emotional Burden	Age, years	-0.02	-0.21	-0.03	-0.001	<b>0.04</b>
	Female	0.03	0.01	-0.34	0.39	0.89
	Not married/cohabitating	0.17	0.09	-0.22	0.56	0.39
	Financial comfort, not enough	-0.09	-0.04	-0.59	0.42	0.74
	Diabetes $\leq$ 5 years	0.13	0.07	-0.26	0.51	0.51
	Have not attended DSMES	-0.09	-0.05	-0.46	0.26	0.59
	Coronavirus Impact	0.96	0.051	0.57	1.35	<b>&lt;0.001</b>
	Overall R <sup>2</sup> = 0.35					
Regimen	Age, years	-0.01	-0.08	-0.03	0.01	0.40
	Female	0.28	0.10	-0.28	0.84	0.32
	Not married/cohabitating	0.47	0.16	-0.12	1.06	0.12
	Financial comfort, not enough	-0.11	-0.03	-0.88	0.65	0.77
	Diabetes $\leq$ 5 years	0.28	0.09	-0.30	0.86	0.34
	Have not attended DSMES	-0.12	-0.04	-0.67	0.42	0.66
	Coronavirus Impact	1.64	0.56	1.05	2.23	<b>&lt;0.001</b>
	Overall R <sup>2</sup> = 0.38					
Interpersonal	Age, years	-0.02	-0.22	-0.03	-0.002	<b>0.03</b>
	Female	-0.05	-0.03	-0.45	0.35	0.81
	Not married/cohabitating	0.01	0.004	-0.41	0.43	0.97
	Financial comfort, not enough	-0.32	-0.09	-0.78	0.31	0.40
	Diabetes $\leq$ 5 years	0.19	0.09	-0.22	0.60	0.36
	Have not attended DSMES	-0.41	-0.19	-0.79	-0.02	<b>0.04</b>
	Coronavirus Impact	1.04	0.51	0.62	1.46	<b>&lt;0.001</b>
	Overall R <sup>2</sup> = 0.36					
Overall Distress	Age, years	-0.01	-0.17	-0.03	0.002	0.09
	Female	0.08	0.04	-0.31	0.48	0.68
	Not married/cohabitating	0.29	0.14	-0.12	0.71	0.16
	Financial comfort, not enough	-0.17	-0.06	-0.71	0.38	0.54
	Diabetes $\leq$ 5 years	0.21	0.09	-0.21	0.62	0.32
	Have not attended DSMES	-0.17	-0.08	-0.56	0.21	0.38
	Coronavirus Impact	1.19	0.57	0.78	1.61	<b>&lt;0.001</b>
	Overall R <sup>2</sup> = 0.39					

## CHAPTER FIVE. CONCLUSION

### 5.1 Background and Purpose

The overall purpose of this dissertation was to examine factors surrounding type 2 diabetes self-management and prevention. Additionally, because type 2 diabetes and cardiovascular disease (CVD) have shared risk factors and CVD is the most common comorbid condition of diabetes and is associated with increased mortality,<sup>1-4</sup> we examined diabetes in the context of dual self-management as well as the effects of interventions that target risk factors for both chronic conditions. As well, because following dietary recommendations is critical both for disease and risk self-management,<sup>5-7</sup> in two of the dissertation studies the aspects of diet self-management both for patients dually diagnosed with diabetes and CVD were evaluated as well as in a community dwelling sample with high risk for these diseases. As these studies were being completed, we were in the midst of the COVID-19 pandemic, providing an important opportunity to study the impact of COVID-19 on diabetes self-management among patients with diagnosed type 2 diabetes.

The following original manuscripts were included in this dissertation: 1) a qualitative study examining the barriers, facilitators, motivators, and strategies employed by patients dually diagnosed with type 2 diabetes and heart failure as well as their family caregivers; 2) a secondary analysis of data that examined psychosocial predictors of diet quality among individuals at risk for type 2 diabetes and cardiovascular disease; and 3) a cross-sectional study examining the impact of the COVID-19 pandemic on type 2 diabetes self-management and diabetes distress. The purpose of this chapter is to summarize and synthesize the findings of this dissertation. Key findings will be discussed, and the impact of these findings will be examined in relation to what is already known. To further the state of the science, clinical implications of these findings will be addressed and recommendations for future studies provided.



## 5.2 Summary of Findings

Chapter two was a qualitative study of the barriers, facilitators, motivators, and strategies of patient-caregiver dyad adherence to a dual low sodium-diabetic diet. Twelve patient-caregiver dyads participated in the interviews (N=24). Both dyadic and individual level themes emerged from the data. Among the dyadic themes, the most commonly reported barriers to dual low sodium-diabetic diet adherence included authorized lapses, availability of non-adherent foods, eating out, negative influence of a non-supportive caregiver, and confusion with managing the two diets together. The most common facilitators reported by dyads included the positive influence of supportive caregivers, having a support system external to the dyad, formal education on the dual diet, and eating meals together and at home. Motivators shared by the dyads included being able to stop taking prescribed medications as dyads managed diabetes and heart failure through diet alone, as well as feeling better overall due to improved disease symptoms. Commonly reported strategies employed by dyads to manage the dual diet included gradual adaptation to the changing taste of adherent foods through reduction of sodium and sugar intake, utilization of substitution productions, increasing fruit and vegetable intake, meal planning, and reading food labels.

The most common themes to emerge at the individual level focused on patient barriers and motivators, as well as barriers experienced by caregivers. The most common barriers reported at the individual level by patients included strong cravings, feeling limited by the two diets, overeating or eating large portion sizes, and sneaking non-adherent foods without the caregiver's knowledge. Motivators most frequently reported at the individual level by patients focused on fear of dying and a desire to stay alive for other members of the family, such as spouses, children, and grandchildren. Other motivators reported by patients included avoiding symptoms of uncontrolled diabetes and heart failure, as well as a desire to avoid hospitalization due to worsening symptoms. While caregivers contributed to the dyadic discussion of motivators, those addressed at the individual level were specific to the patient. Among the most important themes to emerge from this study was the recognition that patients do not work to adhere to dietary recommendations in isolation, a

finding that contributes to what is known about the important role of family support in the management of type 2 diabetes and heart failure.<sup>8,9</sup>

Chapter three was a secondary analysis of existing data from the Heart Health in Rural Kentucky (HeartHealth) study.<sup>10</sup> The HeartHealth study was designed to examine the effect of a socioculturally-tailored CVD risk self-management intervention among adults in rural Kentucky with two or more CVD risk factors.<sup>10,11</sup> Diet quality contributes to the risk for developing type 2 diabetes and CVD,<sup>7,12-15</sup> and improvements in overall diet quality have been associated with reduced risk for the development of diabetes and CVD.<sup>6,12,13</sup> For the secondary analysis, we aimed to determine psychosocial predictors (anxiety, depression, and fatalism) of a high versus low quality diet at baseline and predictors of response to the dietary education provided as part of a healthy lifestyle intervention. For this purpose, pre- and post-intervention diet quality, as indicated by overall diet quality scores based on the 2010 version of the Healthy Eating Index,<sup>16</sup> were used. A total of 698 participants were included in the analysis.

We conducted binomial logistic regression to determine psychosocial predictors of baseline diet quality to determine psychosocial predictors of response to the intervention. Of the three psychosocial factors, fatalism was a significant predictor of baseline diet quality; anxiety and depression were not significant predictors. Multinomial logistic regression was performed to assess psychosocial predictors of group membership based on baseline and post-intervention diet quality. While neither anxiety nor depression predicted baseline diet quality, fatalism was a significant predictor of low diet quality at baseline. These results are consistent with findings in the literature that have shown higher degrees of fatalism to have a negative impact on engagement with healthy lifestyle behaviors, such as maintaining a healthy diet.<sup>17,18</sup>

To determine psychosocial predictors of response to dietary education, we conducted multinomial logistic regression. Anxiety was found to be a significant predictor of baseline to post-intervention diet quality, with lower levels of anxiety among those individuals who had low diet quality at both baseline and post-intervention and those who had high diet quality at baseline and

post-intervention when compared to those whose diet quality improved from baseline to post-intervention. Depressive symptoms significantly predicted changes in diet quality from baseline to post-intervention, in which those who had high diet quality from baseline to post-intervention were more likely to have low depressive symptoms when compared to those whose diet quality was low at baseline and high at post-intervention. These findings contribute to what is known about the effectiveness of tailored lifestyle interventions on self-management of diabetes and CVD risk behaviors, such as maintaining a healthy diet, and further add to this body of knowledge by examining psychosocial factors that contribute to pre-intervention diet quality and response or non-response to a healthy lifestyle intervention.

Chapter four was a cross-sectional study conducted to examine the impact of the COVID-19 pandemic on diabetes self-management and distress. Because the Diabetes Self-Management Education and Support (DSMES) program is effective in improving self-management behaviors and quality of life among patients with diabetes,<sup>19,20</sup> we also examined whether having attended at least one DSMES class had an impact on diabetes self-management and distress. This study included 86 adults diagnosed with type 2 diabetes. We conducted linear regression analyses to determine whether COVID-19 impact and having attended DSMES classes were predictors of self-management and distress during the pandemic.

The results demonstrated that COVID-19 was a significant predictor of overall diabetes self-management, as well as of adherence to self-management, self-management difficulty, and emotional well-being. The impact of the COVID-19 pandemic was not a significant predictor of recognition of the importance of self-management. Additionally, COVID-19 impact was found to be a significant predictor of overall diabetes distress, as well as a significant predictor of diabetes distress associated with emotional burden, self-management regimen, and interpersonal distress. While COVID-19 impact was a significant predictor of diabetes self-management and distress during the pandemic, having attended DSMES classes was not found to be a significant predictor. The findings from this study demonstrate that greater impact of COVID-19 contributed to poorer

self-management and higher diabetes distress. Though COVID-19 impact did not significantly predict self-management importance, this may be due to the disruption in self-management resource availability as a result of intermittent lockdown measures creating significant barriers to physical activity and food resources.<sup>21-24</sup> However, despite the reduced access to self-management resources, the importance of self-management remained. The findings from this study underscore the importance of interventions focused on strategies for maintaining a healthy lifestyle, particularly when resources are limited, and highlight the need for interventions that better prepare individuals with type 2 diabetes for future emergencies that limit access to self-management resources, such as global pandemic or severe weather.

### 5.3 Impact of Dissertation on the State of the Science

The results of the qualitative study indicate that individuals with diabetes often work in tandem with members of their family to follow healthy diet recommendations, and barriers to adherence are not only experienced at the individual level but are also experienced at the family level. These findings are supported by research examining the impact of family involvement in chronic disease self-management, including dietary adherence, which demonstrate greater adherence, improved health outcomes, and greater quality of life among individuals diagnosed with chronic diseases, such as diabetes and heart failure, when families also participate in the recommended self-management behaviors.<sup>8,25-30</sup> The results from this study can be used to guide interventions that integrate family involvement and address the specific barriers experienced by individuals with type 2 diabetes and heart failure at the dyadic level to better promote adherence to chronic disease self-management.

Results from the secondary analysis of data from the HeartHealth study indicated that, compared to participants who started with low quality diet and did not improve and those who maintained high diet quality from baseline to post-intervention, those whose diet quality improved from pre- to post-intervention had greater odds of having high anxiety. Supported by results of

studies that have demonstrated that a certain level of anxiety is motivational, this could indicate that some anxiety experienced by people with multiple risk factors for type 2 diabetes and CVD could be a motivational force. For example, from the perspective of reframing theory, anxiety provides for some the impetus to focus and take action.<sup>31,32</sup> This would also be congruent with our finding that participants who improved from pre- to post-intervention had higher anxiety than those whose diet quality was high at both pre- and post-intervention since maintaining a high quality diet would not necessitate motivation for those who follow dietary guidelines already. At the same time, our finding that participants with lower fatalism were more likely to consume a high quality diet at both pre- and post-intervention compared to those who improved from low to high quality diet highlights some interesting interpretations. For example, lower fatalism, as was found in those who maintained a high quality diet across the intervention, may be associated with increased engagement in health protecting behaviors, such as maintaining a healthy diet.<sup>18</sup> However, more importantly, this finding indicates that although fatalism was higher among participants who had low diet quality at baseline than among those with high quality diet at baseline, when provided with an intervention tailored to address individual and social barriers to engaging in healthy lifestyle behaviors, fatalism did not present a barrier to improved diet quality, a finding supported by previous studies.<sup>33</sup>

The findings from the study examining the impact of the COVID-19 pandemic on diabetes self-management and diabetes distress contribute to what is known about diabetes self-management and distress during times of crises. With the exception of patients' recognition of the importance of self-management, the negative impact of COVID-19 on all aspects of diabetes self-management (adherence to and ease of self-management, coping with self-management, and overall ability to engage in self-management activities) is not unexpected given the decreased access to food, medications and similar resources and the social distancing policies during the pandemic.<sup>21-24,34-36</sup> That COVID-19 impact was positively associated with higher diabetes distress is also not unexpected.<sup>35,37</sup> However, these results do indicate a need to better prepare patients and our

healthcare systems to deal with unexpected crises.<sup>38</sup> The findings from this study highlight the need for interventions that provide individuals with strategies to manage their diabetes when resources are limited. These findings are further supported by previous research demonstrating poorer self-management capabilities among individuals with limited available resources, such as socioeconomically vulnerable populations.<sup>39,40</sup>

Findings that attendance of DSMES classes was not predictive of either self-management or diabetes distress must be interpreted with caution, as we entered into our regression model a categorical variable comparing patients who had participated in one or more DSMES classes to those who had participated in none. First, it is important to note that those who attended one or more classes were more likely to have been diagnosed with diabetes within the past five years. This is not unanticipated since the recommendation for provider referral to the DSMES program focuses primarily on those patients who are newly diagnosed with diabetes.<sup>41</sup> At the same time, patients who have been self-managing their diabetes for greater than five years, although not having attended a self-management class, are likely to have developed their own management strategies that, even during a crisis such as the pandemic, could have been beneficial. Also of note, we were unable to assess whether number of classes attended predicted self-management or diabetes distress, a limitation of this study which could be a critical component to consider in future research.

#### 5.4 Recommendations for Clinical Practice and Research

Taken together, these findings suggest that supportive others and interventions tailored to address both individual and social barriers may provide successful approaches for improved disease self-management among persons with diagnoses diabetes and risk self-management among those with multiple risk factors. Further, given that barriers to and facilitators of engagement in self-management for diabetes frequently overlap with those for CVD, suggests that approaches to addressing multimorbidity may be most effective, as supported by our findings that self-management of dually diagnosed diabetes and heart failure necessitated strategies that

simultaneously addressed both diseases. It is also supported by our findings that a CVD risk self-management intervention that included a focus on self-management through improved diet quality also improved diet quality among persons at risk for type 2 diabetes. This is highlighted in a joint statement by the American Diabetes Association and the American Heart Association in which the need for research to identify self-management strategies to reduce the overlapping risk factors for the development of diabetes and CVD, and prevention of further complications among those who are dually diagnosed with diabetes and CVD is emphasized.<sup>42</sup> Results of our study of the impact of COVID-19 on self-management and diabetes distress further inform approaches to consider and to study in the future, such as integrating into our patient education a focus on preparation for emergencies and crises, whether acute or chronic.

These findings indicate that further research is needed on family involvement. Of particular importance is understanding how to effectively engage family members in self-care activities for persons with type 2 diabetes. Importantly, engaging family members in healthy lifestyle activities that are recommended for management and prevention of type 2 diabetes and CVD will not only serve to support the patient, but will improve health outcomes for the family. Healthy lifestyle practices are beneficial for everyone. As well, with multimorbidity becoming increasingly common, developing and testing interventions that enhance self-management of multiple chronic diseases can provide clinicians with tools to better support patients with comorbid diagnoses.

The findings from this dissertation provide insight into the specific needs of individuals at risk for or diagnosed with chronic diseases and further provide the perspective of the family members involved in their care. These findings can be used to guide the development of healthy lifestyle programs that address strategies for overcoming self-management barriers among individuals diagnosed with and at risk for developing diabetes and CVD. Through continual evaluation and modification of these programs based on the needs of the individuals for whom the programs are developed, we as healthcare professionals can support this population to achieve better health outcomes.

## APPENDIX

### Interview Guide

1. Tell me what you know about the diabetic and low sodium diets:
  - a. What are the differences between the two diets?
  - b. How do you manage the differences in these diets?
2. (Patient) What helps you adhere to the dual diets?
  - a. What barriers have you encountered with adhering to the dual diet?
  - b. What role has your family member played in your diet?
3. (Caregiver) In your opinion, how well is your family member able to adhere to the dual diet?
  - a. What do you think hinders your family member from adhering to the dual diet?
  - b. How do you assist your family member in adhering to the dual diet?
    - i. What barriers have you encountered helping your family member adhere?
  - c. How do you work together?
4. Do you have preference for more salty or sweet foods?
  - a. When did you become aware of liking more salty or sweet foods?
  - b. How would you say your preferences for foods have changed over time?
  - c. Do you have cravings for foods that are salty or sweet? Breads or pastas?
  - d. Do you like foods that are high in salt or sugar?
  - e. When do you think you were exposed to high salt foods?
  - f. What were your family's eating habits growing up?
    - i. Do you think your family's eating habits have shaped the way you eat?
5. As a pair...
  - a. Would you say that your preferences for salty or sweet foods are different from each other?



- b. How do you manage differences in food preferences?
    - c. How have these preferences in foods affected the way you prepare meals?
- 6. What formal nutrition education have you received on the dual diets? (e.g., outpatient)
  - a. What kind of nutrition education have you received from your primary care doctor?
  - b. What kind of nutrition education have you received from any specialists you see?
  - c. What kind of resources do you use to help you plan meals/recipes?
- 7. What additional thoughts do you have for me?

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## VITA

Leigh Anne Koonmen

### **EDUCATION**

<b>Institution</b>	<b>Degree</b>	<b>Date Conferred</b>	<b>Field(s) of Study</b>
Ferris State University	BSN	2015, May	Nursing
University of Kentucky	BA	2010, May	Psychology, minor in Anthropology

### **PROFESSIONAL EXPERIENCE**

<b>Dates</b>	<b>Institution and Location</b>	<b>Academic Position</b>
October 2019-present	Barnstable Brown Diabetes Center, Lexington, KY	Grants Project Assistant
May 2019-June 2020	Barnstable Brown Diabetes Center, Lexington, KY	Graduate Student Intern
August 2017-May 2019	University of Kentucky College of Nursing, Lexington, KY	Research Assistant

<b>Dates</b>	<b>Institution and Location</b>	<b>Clinical Position</b>
September 2019-June 2020	KC Wellness, Lexington, KY	Registered Nurse, Health Coach
June 2016-September 2019	University of Kentucky Chandler Medical Center, Lexington, KY	Progressive Care Nurse
August 2015-June 2016	University of Kentucky Chandler Medical Center, Lexington, KY	Acute Care Nurse

### **AWARDS AND HONORS**

2020-2021	Mentorship Program (Mentee), Southern Nursing Research Society
2020	PhD Dissertation Research Award
2018-2020	Jonas Nurse Scholar, American Association of Colleges of Nursing
2018-present	Omicron Delta Kappa National Leadership and Honor Society
2017-present	Graduate Fellowship, University of Kentucky College of Nursing
2016-present	Sigma Theta Tau, Delta Psi Chapter
2015-2016	Sigma Theta Tau, Kappa Epsilon at Large
2015-present	National Honor Society of Collegiate Scholars
2015	Summa Cum Laude, Ferris State University
2008-2010	Dean's List, University of Kentucky

### **PUBLICATIONS**

**Koonmen, L. A., & Hieronymus, L. B.** Diabetes Awareness: Know your family's risk for type 2 diabetes. *Diabetes Self-Management*;2020;37(3):32-33.

## **RESEARCH PRESENTATIONS**

### **National**

**Koonmen, L. A.,** Hieronymus, L. B., Rayens, M. K., Lennie, T. A., Miller, J. L., Ickes, M., & Mudd-Martin, G. (2021, August). *COVID-19 impact predicts diabetes distress among individuals with type 2 diabetes*. Poster presentation at the Association of Diabetes Care and Education Specialists; virtual conference.

### **Regional**

**Koonmen, L. A.,** Mudd-Martin, G., Lennie, T. A., Ickes, M., & Moser, D. K. (2021, February). *Effects of a cardiovascular risk reduction intervention on diabetes risk*. Podium presentation at the Southern Nursing Research Society; virtual conference.

**Koonmen, L. A.,** Chung, M. L., Key, K. V., & Mudd-Martin, G. (2020, September). *Qualitative description of geographic and family dietary norm influence on patient-caregiver dyad dietary patterns*. Podium presentation at the Appalachian Translational Research Summit; virtual conference.

### **Local**

**Koonmen, L. A.,** Chung, M. L., Key, K. V., & Mudd-Martin, G. (2020, March). *Qualitative description of dual low sodium-diabetic diet management by patient-caregiver dyads*. Abstract accepted at the University of Kentucky Nursing Scholarship Showcase; conference cancelled due to COVID-19 pandemic.

**Koonmen, L. A.,** Mudd-Martin, G., Voigts, K., & Chung, M. L. (2019, April). *Preliminary results of a qualitative study to examine the barriers, facilitators, motivators, and strategies to dual low sodium-diabetic diet adherence in patient-caregiver dyads*. Poster presentation at the University of Kentucky Nursing Scholarship Showcase; Lexington, KY.

Kirby, S., **Koonmen, L. A.,** Ramey, J., & Stephens, M. (2016, October). *Days without falls...* Podium presentation at the University of Kentucky BSN Residency Program Presentation Celebration; Lexington, KY.

**Koonmen, L. A.** (2015, February). *Nursing substance use disorders analysis*. Poster presentation at Ferris State University; Big Rapids, MI.