Who, What, and How Much: Understanding the Profiles, Preferences, and Valuations of Individuals Likely to Participate in Food as Medicine Programs

Austin Dean Arnold

University of Mississippi

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WHO, WHAT, AND HOW MUCH: UNDERSTANDING THE PROFILES, PREFERENCES, AND VALUATIONS OF INDIVIDUALS LIKELY TO PARTICIPATE IN FOOD AS MEDICINE PROGRAMS

A Dissertation Prospectus presented in partial fulfillment of requirements for the degree of Doctor of Philosophy in the Department of Pharmacy Administration
The University of Mississippi

Austin D. Arnold
August 2023
ABSTRACT

Background: Initial research on food as medicine programs has shown encouraging evidence, but more evidence is needed to identify the most effective models, services, delivery methods, and funding mechanisms. Previously studied programs were designed by the researchers, providers, and public health advocates without input from patients on their preferences. Patient engagement is essential to develop successful programs.

Study Aims: 1) To explore the presence latent classes among individuals with diet-related chronic diseases likely to participate in food as medicine programs; 2) To explore preferences for attributes of food as medicine programs among individuals with diet-related chronic diseases likely to participate; 3) To explore willingness to pay for food as medicine programs among individuals with diet-related chronic diseases likely to participate.

Methods: A cross-sectional study was conducted to collect data from a sample of U.S. adults. A latent profile and discrete choice analyses was conducted to determine latent classes and preferences for program attributes, respectively. A partially de-biased approach was utilized to determine willingness to pay for three common food as medicine programs.

Results: The first study demonstrated four socio-ecologically different groups of individuals interested in food as medicine programs exist – the Socially-Limited Capable, High Propensity Capable, Disengage Capable, Low Propensity Vulnerable. The second study found cost per month was the most important attribute when choosing programs followed by the number of meals supplemented, enrollment and eligibility requirements, and program model. All four groups
preferred the lower cost levels and supplementation of more than one meal per day. Among the program models, the voucher program was the least preferred by all four groups. Cooking demonstrations were the most preferred additional service. The final study indicated respondents were willing to pay in some capacity for participation in food as medicine programs and valued the medically tailored meal program the most.

**Conclusion:** This dissertation highlighted the heterogeneity of individuals likely to participate and their preferences for the design of food as medicine programs. The results allow the design and implementation of future programs to be customized for the needs of specific patient populations.
DEDICATION

I dedicate this dissertation to my parents, who have supported me through all successes, struggles, challenges, and achievements. To my mom for pushing me throughout my academic career and planting the seed to attend pharmacy school that ultimately began this journey; to my dad for handing down his patience, inquisitiveness, and calm demeanor in any situation.
## LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>AIC</td>
<td>Akaike Information Criterion</td>
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<tr>
<td>AIDS</td>
<td>Acquired Immunodeficiency Syndrome</td>
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<tr>
<td>BCH</td>
<td>Bolck, Croon, and Hagenaars</td>
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<tr>
<td>BLRT</td>
<td>Bootstrapped Likelihood Ratio Test</td>
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<tr>
<td>BMI</td>
<td>Body Mass Index</td>
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<td>BRFSS</td>
<td>Behavioral Risk Factor Surveillance System</td>
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<tr>
<td>CBC</td>
<td>Choice-Based Conjoint</td>
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<tr>
<td>CI</td>
<td>Confidence Interval</td>
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<tr>
<td>CMS</td>
<td>Centers for Medicare &amp; Medicaid Services</td>
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<tr>
<td>DC</td>
<td>Disengaged Capable</td>
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<tr>
<td>DC</td>
<td>Dichotomous-Choice</td>
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<td>DGA</td>
<td>Dietary Guidelines for Americans</td>
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<tr>
<td>GED</td>
<td>General Education Development</td>
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<tr>
<td>GusNIP</td>
<td>Gus Schumacher Nutrition Incentive Program</td>
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<tr>
<td>HB</td>
<td>Hierarchical Bayesian</td>
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<td>HbA1c</td>
<td>Hemoglobin A1c</td>
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<tr>
<td>HDL</td>
<td>High-Density Lipoprotein</td>
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<tr>
<td>HHS</td>
<td>Health and Human Services</td>
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<td>HIV</td>
<td>Human Immunodeficiency Virus</td>
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<td>HPC</td>
<td>High Propensity Capable</td>
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<tr>
<td>IBM</td>
<td>International Business Machines Corporation</td>
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<tr>
<td>IHS</td>
<td>Indian Health Services</td>
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<tr>
<td>IRB</td>
<td>Institutional Review Board</td>
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<tr>
<td>LDL</td>
<td>Low-Density Lipoprotein</td>
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<td>LLCI</td>
<td>Lower Level Confidence Interval</td>
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<tr>
<td>LMR</td>
<td>Lo-Mendell-Rubin</td>
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<tr>
<td>LPA</td>
<td>Latent Profile Analysis</td>
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<td>LPV</td>
<td>Low Propensity Vulnerable</td>
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<td>LRT</td>
<td>Likelihood Ratio Test</td>
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<tr>
<td>M</td>
<td>Mean</td>
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<tr>
<td>MCO</td>
<td>Managed Care Organization</td>
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<tr>
<td>MHES</td>
<td>Multidimensional Home Environment Scale</td>
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<tr>
<td>MS</td>
<td>Master of Science</td>
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<tr>
<td>NEMS-P</td>
<td>Perceived Nutrition Environment Measures Survey</td>
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<td>NHANES</td>
<td>National Health and Nutrition Examination Survey</td>
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<tr>
<td>OE</td>
<td>Open-Ended</td>
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<tr>
<td>OR</td>
<td>Odds Ratio</td>
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<tr>
<td>PCORI</td>
<td>Patient-Centered Outcomes Research Institute</td>
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PhD – Doctor of Philosophy
SABIC – Sample Size-Adjusted Bayesian Information Criterion
SD – Standard Deviations
SE – Standard Error
SE – Socio-Ecological
SLC – Socially-Limited Capable
SNAP – Supplemental Nutrition Assistance Program
SPSS – Statistical Package for the Social Sciences
ULCI – Upper Level Confidence Interval
USDA – United States Department of Agriculture
USD – United States Dollar
VA – United States Department of Veterans Affairs
WTP – Willingness To Pay
ACKNOWLEDGMENTS

First, I would like to thank Dr. Meagen Rosenthal for being an incredible mentor throughout my time in the program. She has constantly provided opportunities for me to learn and grow as a researcher and professional – without her help, guidance, and motivation over the past five years this project would not have been realized. Her input and feedback were valuable from the initial conception of the project.

I would also like to thank and Dr. John Bentley, Dr. Anne Cafer, and Dr. Erin Holmes for their expertise, critical analysis, and suggestions for my project. Their feedback was able to help tighten the methodological approach, and ensured I was comfortable and ready to manage the project. I am grateful to have received funding support for this project from the Pharmacy Administration Department Student Research Grant, Medical Marketing Economics Fellow Grant, and Sawtooth Software Academic Grant.

I am grateful to the entire Department of Pharmacy Administration, who have become an incredible support system as I pursued my graduate degree and imparted me immense knowledge and skills for conducting research of the highest quality. I would like to thank all my fellow graduate students, in particular my cohort of Wes, Jenn, Swarnali, and Sonam for being amazing friends, always being there to support and push me to be my best. I would also like to thank Brian Reisetter, Doug Paul, and Amit Patel for their mentorship and friendship during my time in the program. Lastly, I would like to acknowledge my family and friends who are an incredible support system and have helped me in many aspects of life to become the best version of myself.
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CHAPTER 1: AN INTRODUCTION TO DIET QUALITY, FOOD SECURITY, AND FOOD AS MEDICINE PROGRAMS IN THE UNITED STATES
1.1 Background

Suboptimal diet is a major risk factor for developing non-communicable chronic conditions globally, including obesity, diabetes, cardiovascular disease, and certain types of cancer.\textsuperscript{1–5} The prevalence of diet-related chronic conditions in the United States has increased steadily over the past several decades, resulting in suboptimal diet being one of the leading causes of death.\textsuperscript{6–12} The increased prevalence has also created a significant economic burden. In 2016, diet-related chronic conditions accounted for an estimated $480.7 billion in direct healthcare costs and $1.24 trillion in lost productivity for a total economic burden of $1.72 trillion in the U.S.\textsuperscript{13}

Despite the well-established link between diet and chronic conditions, many Americans fail to achieve healthy dietary patterns.\textsuperscript{11,14} Among individual dietary components, the consumption of fruits and vegetables has steadily become a point of emphasis in national guidelines.\textsuperscript{15} A growing body of evidence has shown that suboptimal fruit and vegetable intake is a risk factor for diet-related chronic conditions and mortality in the U.S.\textsuperscript{1,4,16–21} However, only 12% and 9% of adults meet the recommended daily intake of fruits and vegetables, respectively.\textsuperscript{22} The development of effective strategies to improve dietary behaviors and healthy food consumption is pivotal to reduce the health and economic impact of diet-related chronic conditions in the U.S.

In the past several decades, health care providers and public health advocates have attempted to identify and develop new strategies to address the growing impact of diet-related chronic conditions. An emerging body of literature indicates that food- and nutrition-related interventions offered within the healthcare system are a possible solution. Early experimental studies exploring these interventions have shown improved health outcomes and reduced healthcare usage and costs.\textsuperscript{23–31} The preliminary results highlight the potential for food- and
nutrition-related interventions to play a prominent role in the prevention, management, and treatment of diet-related chronic conditions in the U.S.32 Furthermore, these interventions can improve overall population health if sustainable, replicable, and scalable methods are developed for broad deployment across the entire healthcare system.33

Interventions studied in prior literature have been primarily designed by public health advocates, researchers, and health care providers with little to no input from patients on their preferences before implementation. As research moves past the conceptual and preliminary stages, patient engagement beyond the traditional study participant role will be essential to develop successful interventions for broad implementation. Patient involvement during the research process allows their perspectives to influence the development, dissemination, and use of evidence-based knowledge to better reflect and meet their healthcare needs.34,35 This leads to increased quality and appropriateness of the research, ultimately improving healthcare interventions and promoting greater uptake by patients.36,37 Prior literature has shown that food- and nutrition-related interventions can address the growing impact of diet-related chronic conditions; however, patient perspectives about the attributes, design, and implementation of such interventions are needed.

This dissertation adds to prior literature by identifying target patient populations and gathering their preferences to facilitate the development of future interventions. More specifically, the purpose of this dissertation was to establish profiles of patients interested in food as medicine programs, understand their preferences for program attributes, and determine their willingness to pay for different programs. The remainder of this chapter provides an overview of diet quality in the U.S., the Socio-Ecological (SE) model, SE factors affecting diet quality, food security, food as medicine programs, and patient-centered research. An explanation of the need for study, research
significance, and specific aims are provided at the end of this chapter. Chapter 2 of this dissertation determines latent groups of individuals likely to participate in food as medicine programs based on SE factors. In Chapter 3, overall and group preferences for different food as medicine program attributes is examined through a discrete choice experiment. An evaluation of willingness to pay for food as medicine programs among the identified groups is presented in Chapter 4. Lastly, Chapter 5 summarizes the findings of the three studies, discusses the practical implications, and recommends future directions for research on food as medicine programs.

1.2 Diet quality in the United States

The relationship between diet and health has been well documented, with substantial evidence indicating that optimal dietary patterns help individuals achieve a healthy lifestyle and reduce the risk of developing chronic conditions throughout life.\(^{38}\) However, many Americans fall short of meeting the recommendations established in the *Dietary Guidelines for Americans* (DGA) developed by the U.S. Department of Agriculture (USDA) and Health and Human Services (HHS).\(^{38}\) Although reported measures of overall diet quality have modestly improved in recent years, 32% of adults and 49% of children still have overall poor quality diets.\(^{14,39–41}\) Concurrently, 60% of adults have one or more diet-related chronic condition.\(^{38}\) The burden of associated morbidities, mortality, health care costs, and lost wages due to diet-related chronic conditions pose a substantial public health problem.\(^{13,42–45}\)

According to guidelines, an optimal diet entails consuming high amounts of fruits, vegetables, whole grains, and healthy protein sources (e.g., legumes, seafood, lean protein) while minimizing added sugars, salt, processed foods, and saturated fats.\(^{38,46}\) The consumption of fruits and vegetables is a point of emphasis in the current DGA, as evidence has shown that suboptimal produce intake is a major contributor to an increased risk of diet-related chronic conditions and
mortality. Depending on age and sex, the DGA recommends adults consume approximately two (2) cup equivalents (~4 servings) of fruit and two and one-half (2.5) cup equivalents (~5 servings) of vegetables per day. However, only 12% and 9% of adults meet the recommended daily intake of fruits and vegetables, respectively. On average adults only consume approximately one (1) cup equivalent of fruit and less than two (2) cup equivalents of vegetables per day.

The consumption of ultra-processed food also impacts diet quality and the risk of developing diet-related chronic conditions. Ultra-processed foods are industrially manufactured food options that contain various additives such as dyes, flavorings, or preservatives, and are largely devoid of whole foods. This includes items like frozen dinners or pizzas, fast food, sweet or salty snacks, and soda. Between 2002 and 2018, the percent of calories consumed via ultra-processed foods in the US grew from 53.5% to 57%, while the percent of calories from whole foods decreased from 32.7% to 27.4%. These trends in the consumption of ultra-processed and whole foods further exacerbate the risk of developing diet-related chronic conditions. Previous literature has found that diets high in ultra-processed food result in a greater intake of total calories, total fat, saturated fat, trans-fat, sugar, and sodium while providing less protein, fiber, and essential vitamins and minerals. As such, the over consumption of ultra-processed food is associated with diet-related chronic conditions like obesity, type 2 diabetes, hypertension, cardiovascular disease, and cancer.

The relationship between diet and health-related outcomes highlights the need for interventions that improve diet quality among Americans. Diet quality is shaped by a complex mix of individual, social, and environmental factors that must be considered when adapting guidelines to meet the specific needs of patients, especially those with chronic conditions. The DGA and other
guidelines can serve as a reference for Federal, medical, voluntary, and patient care organizations developing clinical nutrition guidance and interventions as part of a multifaceted treatment plan.  

1.3 The Socio-Ecological Model

The SE model is a social behavior theory that emphasizes the impact of individual, social, and environmental aspects on individual behavior. Bronfenbrenner (1977) first theorized the framework as an ecological systems theory and conceptual model for understanding human development. The initial theory illustrated nested spheres with the individual in the center surrounded by micro-, meso-, exo-, macro-, and chronosystems. The micro- and meso-systems directly impact the individual, encompassing the interactions and relationships of the immediate surroundings, and direct contact with the individual (e.g., work, school), respectively. The remaining systems have an indirect impact on the individual such that exosystem relates to community contexts and social networks; macrosystem is societal, religious, and cultural values and influences; chronosystem contains both elements of time and historical content, plus policy influences in revised models.

The work of McLeroy and colleagues (1988) innovated the initial framework and conceptual model for use in the promotion of health-related behavioral change. The health-related SE model approaches behavior change by considering five spheres of influence: individual, interpersonal, organizational, community, and policy. In this model, individual, or intrapersonal, factors represent characteristics of the individual, such as sociodemographic and psychosocial factors; interpersonal factors encompass social networks such as family, friends, cultural or religious membership, and other social groups; organizational factors involve social institutions and social organizations; community factors include relationships between individuals and local organizations or institutions, and populations associated with a specific entity (e.g., political party);
Figure 1.1 Socio-ecological model depicting the multiple influences on dietary behaviors (based on Story et al., 2008)

Figure 1.2 Socio-ecological model depicting the multiple influences on participation in food as medicine programs
and policy factors indicate laws and regulations. Subsequent utilization, including revisions and adaptations, of the SE model has occurred in public health promotion, violence prevention, healthy college campuses, geriatric preventive health, and colorectal cancer prevention.

The conceptual framework used to guide this dissertation was the SE model of health behavior adapted by Story and colleagues (2008). The model, presented in Figure 1.1, considers four broad spheres of influence related to healthy dietary behaviors: individual, social environment, physical environment, and macro-level environment. In this model, individual factors include cognitions, attitudes, skills and behavior, lifestyle, biological factors, and demographics; social environment factors include interactions with family, friends, peers, and community members; physical environment factors include places such as homes, school, worksites, neighborhoods, restaurants, and retail food outlets; and macro-level environment factors encompass the influence of food systems, legislation, policy, and societal norms. This adapted SE model was utilized because dietary behaviors are shaped by a complex interplay of individual, social, and environmental factors. Previous literature has identified multiple determinants in each sphere related to dietary behaviors and produce consumption, which could also impact participation in nutrition-related interventions. The SE model adapted for this study is presented in Figure 1.2 and discussed further in the following section.

1.4 Socio-ecological factors affecting diet quality

The adapted version of the SE model developed for this dissertation includes three spheres: individual, social environment, and physical environment. This model was utilized to identify factors impacting dietary behaviors and potential participation in nutrition-related interventions. According to previous literature sociodemographic characteristics, psychological characteristics, lack of knowledge or skills, family and social support, price and affordability, accessibility, and
geographical availability are all factors affecting dietary behaviors. These factors can be separated into the three distinct spheres of the model: individual, social environment, and physical environment. These factors were utilized throughout this dissertation to identify target populations and elicit preferences that support the development of sustainable interventions for specific populations.

The impact of individual-level factors on dietary behaviors, and in turn health-related outcomes, is particularly evident when comparing different sociodemographic characteristics. Previous literature has suggested income and education levels are correlated with overall diet quality in addition to fruit and vegetable intake. According to the 2015 Behavioral Risk Factor Surveillance System data only 7% of adults living at or below the federal poverty level met the recommended vegetable intake compared to 11% of adults at the highest income level. A similar trend was found for fruit intake, but the difference was less pronounced (11.9% vs. 13%). Furthermore, individuals of lower socioeconomic status tend to purchase fewer fruits and vegetables, more sugar-sweetened beverages, and more inexpensive, calorie-dense foods that are high in fat and less nutrient-rich. Diet quality has also been differentiated in the literature by age, race, and ethnicity.

Additional individual-level factors affecting dietary behaviors include self-efficacy, attitude, and cooking confidence. Individual confidence in one's ability, or self-efficacy, to consume healthier food or more fresh produce can generate the motivation and pre-planning of change, which can translate into improved dietary behaviors. Cooking confidence and skills are essential to encourage self-efficacy in healthy food consumption. Intervention studies designed to improve cooking skills and home-cooking confidence have resulted in participants including more produce at mealtimes. Lastly, literature has shown positive attitudes toward healthy
eating lead to consumption of higher quality diets regardless of shopping at low-, medium-, or high-priced supermarkets. This implies consuming a high quality diet is possible if individuals have a positive attitude toward healthy eating, even if they shop at low-priced supermarkets.

Social environment-level factors influencing dietary behaviors include interactions with family, friends, peers, and community members. The impact of a social environment begins in childhood, as parents control early experiences with food and exhibit their own dietary behaviors, taste preferences, and choices – presumably influencing future behavior in adulthood. In adults, high levels of family and social support has been recognized as a major influence for improved health and dietary outcomes, diet quality, success in diet-related interventions, and adherence to dietary recommendations. Cultural influences present in different social environments, like consumption of traditional foods or body image preferences, may also impact dietary preferences and behavior, particularly in minority populations.

Physical environment-level factors affecting dietary behaviors include the availability, accessibility, and affordability of healthy food options. The proximity of supermarkets and density of food retailers that provide healthy options (e.g., grocery stores) compared to less healthy options (e.g., convenience stores, fast food restaurants) in a community are necessary to increase availability of high quality food. Previous literature has suggested proximity to a supermarket and availability of nutritious food retailers are associated with healthier food consumption and lower risk of a poor quality diet. However, availability of appropriate food retailers does not necessarily ensure accessibility for everyone.

Accessibility is relative and multi-dimensional, involving factors like store location and hours, distance and travel time, availability of transportation, personal mobility, cultural appropriateness, and access to appropriate funds. Issues of accessibility to healthy food
options, like fresh produce, have been found to disproportionately affect low-income and minority communities, which tend to have fewer supermarkets and more convenience stores available. Lastly, the cost and affordability of healthy options within the local environment have a major influence on individual purchasing power and consumption of high quality food. High quality diets and healthy food options, like fresh produce, tend to be more expensive and less calorie dense than lower quality alternatives. Thus, individuals with limited income or lower socioeconomic status tend to purchase lower quality options that are highly processed, lack necessary nutrients, and contain high amounts of fats, sugar, and sodium compared to healthier options. These determinants identified in previous literature were utilized to identify target patient populations and understand their preferences to support the development of sustainable interventions.

1.5 Food security

Food security is the ability to access enough food for an active and healthy lifestyle, which has become a common social determinant of health. According to the USDA, food security can be categorized into four levels: high, marginal, low, and very low. Food secure households are characterized as having constant access to enough food for an active, healthy life for all members. Conversely, food insecure households are uncertain of having, or unable to acquire, enough food throughout the year to meet the needs of all members due to lack of money or other resources. Food insecure households include those with low and very low food security.

Public health and health care models examining social determinants of health have contributed to the increased recognition of complex social, cultural, economic, and geographical factors impacting the accessibility and affordability of healthy food options. In 2020, approximately 10.5% of all U.S. households (13.8 million households) and 14.8% of households
with children experienced food insecurity. Food insecurity is most often due to a combination of financial and structural barriers, which could result in temporary or long-term issues. In 2020, 28.6% of low-income households were food insecure, compared to the national average of 10.5%. Unemployment, especially among low-income populations, also negatively impacts food security by making it more difficult to meet basic household food needs. Furthermore, disparities in food insecurity exist among racial and ethnic groups. In 2020, rates of food insecurity in Black, non-Hispanic (21.7%) and Hispanic (17.2%) households were higher than the national average.

Structural barriers to food access also impacts food security. Individuals living in some urban, rural, low-income, and predominantly Black or Hispanic neighborhoods tend to have limited access to full-service supermarkets or grocery stores. In these areas convenience stores and small independent stores are more common, which tend to have higher prices, less variety, and lower quality food options. Furthermore, lack of transportation and traveling long distances to supermarkets or grocery stores in these areas negatively impact food security. These areas or communities that lack access to locations with affordable and nutritious food options are commonly known as “food deserts”.

Previous literature has demonstrated the negative effect of food insecurity, which is associated with lower intake of fruits and vegetables, fewer healthy foods served at meals, and greater consumption of inexpensive nutrient-poor foods. Consequently, individuals experiencing food insecurity have higher rates of obesity, cardiometabolic disease, mental distress, and functional limitations. Food insecurity is also linked to lower-self efficacy in managing chronic conditions due to mental and financial stressors, such as high cost medications and other health care expenses. In addition to these health-related consequences, food
insecurity is associated with changes in dietary behaviors and perceptions.\textsuperscript{139,140} Although affected individuals perceive healthy eating as beneficial, many also view it as inconvenient.\textsuperscript{139} Difficulty balancing the value of healthy eating with efforts to stretch food budgets can lead to changes in dietary behaviors, like eating fewer fruits and vegetables, that negatively impact health-related outcomes.\textsuperscript{141,142}

1.6 Food as medicine programs

Based on the relationship poor quality diets and food insecurity has on diet-related chronic conditions, there has been a growing interest to implement food as medicine programs within the healthcare system. These programs seek to provide healthy food as a treatment option for vulnerable patients.\textsuperscript{143} A recent systematic scoping review identified six models currently being used within healthcare settings to improve patient access to fresh produce.\textsuperscript{144} These models include: 1) cash-back rebate programs, 2) voucher programs, 3) garden-based programs, 4) subsidized food packages, 5) prepared-meal delivery services, and 6) clinical–food bank collaborations.\textsuperscript{144} Among these models voucher programs, subsidized food packages, and prepared-meal delivery services have been the most studied in the literature.\textsuperscript{144,145}

Voucher programs provide incentives, funds, or redeemable coupons for specified amounts to purchase produce at predetermined locations such as grocery stores, supermarkets, farmers’ markets, or mobile markets.\textsuperscript{144} Most programs in this category are described as food prescription programs and require individuals receive referral from a health care provider after being identified as at risk for food insecurity or diet-related conditions.\textsuperscript{144,145} Subsidized food package programs provide patients with a pre-assembled bags or boxes completely or partially paid for by the administering healthcare organization.\textsuperscript{144} These food packages often include a choice of minimally prepared items, like fresh produce, selected by a qualified nutrition professional (e.g., Registered
Dietitian Nutritionist) and tailored for a specific medical diagnosis or condition.\textsuperscript{145} Prepared-meal delivery services are often medically tailored, ready-to-eat meals developed by a Registered Dietitian Nutritionist to meet the specific dietary needs of a medical condition. The meals are delivered directly to participants after referral by a health care provider or insurance plan.\textsuperscript{145}

Overall there is evidence indicating food as medicine programs positively impact dietary outcomes through increased produce consumption and reduced food insecurity.\textsuperscript{29,144–155} Pooled results from a meta-analysis of food prescription programs found daily combined fruit and vegetable intake significantly increased by 22\%.\textsuperscript{154} This translated to an increase in combined intake of 0.8 servings per day.\textsuperscript{154} Individually, fruit intake significantly increased by 39\% or 0.6 servings per day, and vegetable intake also increased by 29\% or approximately 0.5 servings per day.\textsuperscript{154} However, literature on health-related and cardiometabolic outcomes have reported mixed effectiveness.\textsuperscript{144,154,155} Pooled results from the meta-analysis found only a modest change in BMI and HbA1c, which corresponded to an absolute change of $-0.6 \text{ kg/m}^2$ and $-0.8\%$, respectively.\textsuperscript{154} Furthermore, no significant effects were observed for blood pressure or blood lipids (e.g., LDL, HDL, triglycerides).\textsuperscript{154} Similar inconsistency in health-related outcomes have been reported in other types of food as medicine programs.\textsuperscript{144,145} These inconsistent findings may be due in part to lack of randomized studies and substantial heterogeneity in research designs, amount of food provided, duration of programs, and outcomes measured.\textsuperscript{144,154,155} Nevertheless, these diet and health-related outcomes together provide encouraging evidence that food as medicine programs can impact diet quality and potentially improve health outcomes over longer periods of time.

1.7 Funding food as medicine programs

Increased pressure to improve health-related outcomes and control healthcare costs incurred by diet-related chronic conditions has made health care payers, providers, and
policymakers increasingly interested in food as medicine programs. Despite encouraging outcomes and national focus, lack of sustainable funding has been identified as the foremost barrier to maintaining and expanding these programs.\textsuperscript{156} Funding to support the research and development of food as medicine programs is predominantly provided on a limited or pilot basis by community-based organizations, research institutions, and private, local, or state grants.\textsuperscript{33,157,158} The dependence on these soft funding mechanisms is a significant barrier because health care institutions and community-based organizations often lack the necessary resources to independently develop and maintain programs long-term.\textsuperscript{33} Thus, identifying funding mechanisms to support collaborative, scalable, and sustainable financing of food as medicine programs is important to improve the quality and reach.

The U.S. healthcare system has historically not provided funding to support food access, but new policies are emerging as the literature on the benefits of nutrition-related interventions grows. Currently, Medicaid and Medicare programs have several promising pathways that can be used to provide funding for the delivery of food as medicine programs to low-income individuals affected by diet-related chronic conditions.\textsuperscript{156} These options are presented in Table 1.1 and include Special Supplemental Benefits for the Chronically Ill within Medicare Advantage plans; Section 1115 and Section 1915 waivers within Medicaid; and In Lieu of Services, Activities that Improve Health Care Quality, and Value-Added Services options within Medicaid Managed Care Organizations (MCO).\textsuperscript{156} Table 1.1 presents a description and examples of these potential funding options. In addition to Medicaid and Medicare, private healthcare payers have begun exploring food as medicine programs to improve health outcomes and control costs. In 2017, Geisinger Health in Pennsylvania implemented the Fresh Food Pharmacy program that provides food prescriptions to patients with diabetes for access to 10 weekly meals of fresh, healthy food.\textsuperscript{159}
Table 1.1 Potential Medicaid and Medicare funding options for the delivery of food as medicine interventions, adapted from *Mainstreaming Produce Prescriptions: A Policy Strategy Report* by Garfield et al., 2021

<table>
<thead>
<tr>
<th>Insurer/Plan</th>
<th>Option</th>
<th>Scope/Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medicare Advantage Plan</td>
<td>Special Supplemental Benefits for the Chronically Ill</td>
<td>Allows Medicare Advantage plans to cover additional supplemental benefits for enrollees who: (1) have “one or more comorbid and medically complex chronic conditions;” (2) have “a high risk of hospitalization or other adverse health outcomes;” and (3) require “intensive care coordination.”</td>
<td></td>
</tr>
<tr>
<td>Medicaid</td>
<td>Section 1115 Demonstration Waivers</td>
<td>Allows CMS to waive certain provisions of the Medicaid Statute and provide federal funds to pay for services and populations that would not otherwise be covered. Waivers could be used to fund food as medicine interventions as part of value-based models designed to address health-related social needs.</td>
<td><strong>Massachusetts:</strong> $149 million Flexible Services Program establishes funding for Medicaid Accountable Care Organizations to provide food and housing support to certain enrollees. <strong>North Carolina:</strong> $650 million Healthy Opportunities Pilots program where pilots may cover up to $200 per month of produce prescription programs for certain enrollees.</td>
</tr>
<tr>
<td>Medicaid</td>
<td>Home and Community-based Services Waivers (Section 1915(c) and 1915(i))</td>
<td>Allows CMS to waive certain provisions of the Medicaid Statute and provide federal funds to pay for home and community-based services to keep enrollees out of institutional care. States may not provide “room and board” under these waivers, but CMS has allowed states to cover meals, provided they do not constitute a “full nutritional regimen”.</td>
<td><strong>Illinois:</strong> currently has three 1915(c) waivers that provide home- and community-based services, including coverage of meals, for individuals living with HIV/AIDS, brain injuries, or disabilities.</td>
</tr>
</tbody>
</table>

CMS = Centers for Medicare & Medicaid Services; HIV = Human Immunodeficiency Virus; AIDS Acquired Immunodeficiency Syndrome
Food as medicine programs will ultimately need to be integrated and funded through the healthcare system via public and private insurance to achieve full-scale implementation and population-level outcomes. However, the standard of evidence for the long-term impacts on individual health, public health, and cost-related outcomes has not reached the threshold required by insurance payers. Federal, state, and local funding for public health and food assistance programs must be utilized in the short-term to promote the development of programs and build the evidence needed to establish long-term funding mechanisms through insurance providers. The Agriculture Improvement Act of 2018, also known as the Farm Bill, expanded funding for individuals in the Supplementation Nutrition Assistance Program (SNAP) to increase produce consumption. The bill also established the Gus Schumacher Nutrition Incentive Program.
(GusNIP), which offers federal grants to support nutrition incentives and Produce Prescription Programs targeting low-income households. Additionally, this program set aside funding to support the development of new programs with $45 million available in 2019 and up to $56 million available by 2023. Although these sources provide necessary funding for program development in the short-term, identifying additional collaborative and more sustainable funding mechanisms is crucial. The establishment of long-term funding will generate the evidence needed to expand the reach of programs and support widespread integration in the healthcare system.

1.8 Patient-centered research

Over the past several decades there has been a paradigm shift from more traditional, top down research approaches to an emphasis on engagement from patients and other stakeholders (e.g., caregivers). Patient engagement, broadly called patient-centered research, emphasizes collaboration between researchers and patients to lead or partner in producing mutually beneficial research projects and outcomes. The involvement of patients in research allows their lived experiences to influence the development of more relevant evidence-based research reflecting their health care needs. In turn, patient engagement can encourage easier recruitment, better retention, and improved interpretation in research, which leads to more robust and relevant outcomes. Increased quality, appropriateness, and translatable outcomes from patient-centered research can improve health care interventions and promote greater uptake within the healthcare system.

Previous literature has shown patient-centered research contributes to the development of research questions and outcomes of importance to patients and caregivers. A qualitative review by the Patient-Centered Outcomes Research Institute (PCORI) found patients and other stakeholders provided valuable contributions regarding research questions, study designs, study
outcomes, and tailoring interventions.\textsuperscript{169} Additionally, patient engagement can increase feasibility, acceptability, rigor, and relevance of research projects.\textsuperscript{169} A scoping review identifying factors associated with positive outcomes in multimorbidity interventions found providing a patient-centered approach was an important aspect in successful interventions.\textsuperscript{170} One of the most common elements utilized in patient-centered approaches is creating individualized interventions to meet patients’ needs and enhance health-related outcomes.\textsuperscript{170} Patient engagement in research regarding food as medicine programs can support the creation of evidence-based interventions to meet needs and preferences of specific populations. This should ultimately increase engagement and retention in programs leading to improved diet- and health-related outcomes.

1.9 Need for study

Initial research on food as medicine programs have shown encouraging evidence for the potential to reduce food insecurity, improve diet quality, and impact health-related outcomes among participants. However, given that integration into the healthcare system is the most likely mechanism for long-term success, more robust evidence is needed to advance the strategic development of these programs. As research of programs moves beyond the pilot testing phase, empirical questions identifying the most effective models, services, and delivery methods for specific populations need to be addressed.\textsuperscript{143, 156, 171} Furthermore, the development of sustainable funding mechanisms through private, public, and governmental stakeholders will be necessary to promote scalability and implementation of programs across the U.S. As future research begins to address these questions, incorporating patient input throughout the entire research process will be essential to develop successful food as medicine programs.

There is growing consensus about the crucial role of public and patient engagement in the research process, which improves the credibility of results and direct applicability to patients.\textsuperscript{167}
According to PCORI, research driven by patient interests and needs is more likely to be taken up and used to address individual health needs.\textsuperscript{172} An analysis of PCORI research studies in 2019 showed engagement of patients and public members as consultants or collaborators provided valuable contributions in defining research questions, determining study design, selecting outcomes, and tailoring interventions.\textsuperscript{169} Furthermore, many studies reported increased enrollment, retention, feasibility, acceptability, rigor, and relevance of the research suggesting engagement provides better alignment with patients’ and clinicians’ real-world needs and concerns.\textsuperscript{167,169}

Food as medicine programs to this point have been developed by researchers and other professionals to provide conceptual proof of the impact on diet- and health-related outcomes. As research on the development and impact of these programs moves beyond the pilot phases, patient engagement throughout the entire research process will be vital to long-term success and uptake by the healthcare system. As such, this dissertation enhances current literature by identifying patients interested in food as medicine programs, understanding their preferences for program attributes, and determining their willingness to pay for different programs. More specifically, socio-ecological factors were utilized to identify latent profiles of individuals to create target populations of patients interested in food as medicine programs. Additionally, differences in program preferences and willingness to pay between the identified latent profiles were explored to facilitate the development of tailored programs for specific patient populations. A conceptual diagram of this dissertation is provided in Figure 1.4. The exploration of target patient profiles and preferences provides future research the opportunity to develop tailored programs for specific patient needs, which should ultimately increase engagement, improve health-related outcomes, and support the uptake of interventions by the healthcare system.
1.10 Specific aims and objectives

The specific aims and objectives for this dissertation were as follows:

1. To explore the presence latent profiles among individuals likely to participate in food as medicine programs.
   a. To identify latent profiles of individuals likely to participate in food as medicine programs based on socio-ecological indicators.
   b. To assess the sociodemographic and health-related predictors of membership in the identified latent profiles.
   c. To examine differences in the likelihood to participate in food as medicine programs among the identified latent profiles.

2. To explore preferences for attributes of food as medicine programs among individuals likely to participate.
   a. To examine preferences of food as medicine program attributes among individuals likely to participate.
   b. To examine differences in the preferences of food as medicine program attributes among identified latent profiles of individuals likely to participate.

3. To explore the willingness to pay for food as medicine programs among individuals likely to participate.
   a. To examine the willingness to pay for food as medicine programs among individuals likely to participate.
   b. To examine differences in the willingness to pay for food as medicine programs among identified latent profiles of individuals likely to participate.
Figure 1.3 Conceptual diagram of the dissertation
CHAPTER 2: UNDERSTANDING SOCIO-ECOLOGICAL FACTORS OF INDIVIDUALS LIKELY TO PARTICIPATE IN FOOD AS MEDICINE PROGRAMS: A LATENT PROFILE ANALYSIS
2.1 Background

Suboptimal diet quality and intake is a major risk factor for developing chronic conditions, such as obesity, diabetes, cardiovascular disease, and certain types of cancer.\textsuperscript{1–5} The prevalence of these chronic conditions has consistently increased in the U.S. for several decades and many have become a common cause of death.\textsuperscript{6–12} The increased presence of diet-related chronic conditions has created a significant economic burden in the U.S. as well.\textsuperscript{13} Despite understanding the importance of diet, many Americans fail to achieve healthy dietary patterns.\textsuperscript{11,14} The development of effective strategies to improve dietary behaviors and healthy food consumption is pivotal to reduce the impact of diet-related chronic conditions in the U.S.

According to guidelines, an optimal diet entails consuming high amounts of fruits, vegetables, whole grains, and healthy protein sources while minimizing added sugars, salt, processed foods, and saturated fats.\textsuperscript{38,46} The consumption of fruits and vegetables has become a point of emphasis, as literature indicates that suboptimal fruit and vegetable intake contributes to the risk of diet-related chronic conditions and mortality.\textsuperscript{1,4,16–21} In the U.S., adults on average consume one less cup equivalent of fruits and vegetables per day than recommended.\textsuperscript{38} Overall, only 12\% and 9\% of adults meet the recommended daily intake of fruits and vegetables, respectively.\textsuperscript{22}

Food as medicine programs provide access to healthy foods, especially fresh fruits and vegetables, through various mechanisms as a form of treatment for chronic conditions in vulnerable patients.\textsuperscript{143} A recent systematic scoping review identified six models currently being used within healthcare settings to improve patient access to fresh produce.\textsuperscript{144} Among these models, voucher programs, subsidized food packages, and prepared-meal delivery services have been the most studied.\textsuperscript{144,145} Overall, food as medicine programs have shown improved dietary outcomes.
through increased produce consumption and reduced food insecurity. However, these programs have shown mixed results for health-related and cardiometabolic outcomes due in part to short follow-up times in previous studies. As food as medicine programs become more widely accepted and implemented, the ability to identify and screen potential participants into the right type of program will be necessary.

A complex interplay of individual, social, and environmental factors shapes individual dietary behaviors and consumption. At an individual level, low socioeconomic status is correlated with the purchase of fewer fruits and vegetables, more sugar-sweetened beverages, and more inexpensive, calorie-dense foods that are high in fat and less nutrient-rich. Self-efficacy to consume a healthier food or fresh produce generates motivation and preplanning of change, eventually leading to improved healthy eating behaviors. Furthermore, cooking confidence and skills are essential components of self-efficacy in healthy food consumption. At a social level, high amounts of family, friend, and peer support has been recognized as a major influence on improved health and dietary outcomes, diet quality, success in diet-related interventions, and adherence to dietary recommendations. At an environmental level, the availability of healthy options in the physical area and local community has been associated with healthier food consumption and lower risk of poor quality diet. Accessibility and affordability have also been found to influence diet quality.

As the feasibility and scalability of food as medicine programs continue to be examined, empirical questions identifying the most effective models, services, and delivery methods for specific patients and populations need to be addressed. A comprehensive understanding of baseline socio-ecological factors and formation of a systematic, comprehensive, and efficient way to classify patients should allow programs to be tailored to the needs of specific populations.
The Socio-Ecological (SE) Model is a social behavior theory that emphasizes the impact of individual, social, and environmental aspects on individual behavior and was used to understand the role these factors play on individuals’ interest in food as medicine programs.

The original framework has been adapted for use in diet-related behavioral change by Story et al. and implies that behavior is affected by four spheres of influence: (a) individual, (b) social environment, (c) physical environment, and (d) macro-level environment. The model used in this study focused on the three spheres of health influences in relation to participation in food as medicine programs: (a) individual, (b) social environment, and (c) physical environment. Previous literature has identified multiple determinants at each level of the adapted model related to dietary behaviors and produce consumption, which may also impact participation in food as medicine programs. A better understanding of those interested in participating in food as medicine programs and development of latent profiles will allow programs to be tailored and implemented for specific populations based on socio-ecological predictors.

As such, this study intended to understand the latent profiles of individuals with diet-related diseases based on socio-ecological factors. Furthermore, this study aimed to assess the association of profile membership with the likelihood of participating in food as medicine programs. Application of the SE model in this study will allow the identification of target populations of individuals with diet-related conditions interested in food as medicine programs, which will facilitate the development of tailored programs in future research.

2.2 Study objectives

- To identify latent profiles of individuals likely to participate in food as medicine programs based on socio-ecological indicators.
• To assess the sociodemographic and health-related predictors of membership in the identified latent profiles.

• To examine differences in the likelihood to participate in food as medicine programs among the identified latent profiles.

2.3 Methods

Study design

A prospective cross-sectional study design employing an online survey was conducted with data collected from a nationally representative sample of the U.S. adult population. Data were collected via an online survey fielded through Qualtrics survey software (Qualtrics Inc., Provo, UT). Survey responses were collected anonymously from participants to ensure that only nonidentifiable data were available to researchers. Exemption from the University of Mississippi Institutional Review Board (IRB) was given before the initiation of the study (protocol #23x-103).

Study sample

Respondents were recruited through research panels provided by Qualtrics (Qualtrics Inc., Provo, UT). Quota-based convenience sampling was used to ensure that final respondent characteristics were representative of the U.S. populations based on age, gender, race, and ethnicity. Panel members were eligible to participate in the study based on the following inclusion criteria: aged 18 years or older, English-speaking, diagnosed with at least one diet-related chronic condition, and likely to participate in food as medicine programs. A screening questionnaire was used to determine eligibility based on the presence of diet-related conditions and the likelihood of participation. Dichotomous response questions (e.g., yes/no) were used to elicit physician diagnoses of diet-related conditions and a rating scale response question was used to assess the likelihood of participation. Individuals without a diagnosis for at least one prespecified condition
and those indicating they are unlikely to participate in food as medicine programs were excluded from the study. Previous literature recommends a minimum sample size of approximately 500 individuals is appropriate to provide accurate results for the statistical analyses used in this study. Based on this approximation the target sample size for the study was 600 respondents to ensure an adequate number of responses were received to account for any missing data. Respondents provided informed consent prior to completing the survey.

**Data collection**

A self-administered, online survey was used to collect data from eligible respondents. The survey collected data regarding socio-ecological predictors related to diet behaviors and food consumption, likelihood to participate in food as medicine programs, food security, diet-related conditions, and sociodemographic characteristics. Most survey items were identified from previous literature on dietary behavior, preferences, and consumption. Additional survey items were included or adapted from previous literature as necessary to meet the study objectives. The survey was piloted with 59 graduate students before the final data collection. An additional question about dietary restrictions was included based on the feedback from pilot participants. The final version of the survey is provided in Appendix 1 of this dissertation.

**Study variables**

*Latent indicator variables*

The SE model was used to determine study variables for data collection and analyses. Previous literature has identified multiple socio-ecological factors related to dietary behaviors and produce consumption, which may impact an individual’s likelihood to participate and preferences for food as medicine programs. The adapted SE model used in this study contains three levels: Individual, Social Environment, and Physical Environment. In the model, Individual-level
determinants include diet self-efficacy, attitude, and cooking confidence. Social Environment-level determinants include family and social support, and cultural influence; and Physical Environment-level determinants include home food environment, community availability and accessibility, and perceived affordability of healthy food. These factors were utilized in the study as latent profile indicator variables to identify latent groups of individuals likely to participate in food as medicine programs.

*Individual level*

a. Self-efficacy

Healthy eating self-efficacy was measured using a 16-item survey instrument adapted from the previously validated Self-Efficacy for Diet Behaviors survey. The instrument measured self-efficacy by asking respondents to rate their confidence in motivating themselves to achieve healthy eating habits for at least 6 months. Examples of healthy eating habits evaluated in the instrument include consuming more fruits and vegetables; including more “healthy” fats, whole grains, and low- or non-fat dairy products in their diet; avoiding high-fat and salty foods in various situations; eating smaller portions; eating more baked or grilled poultry or fish instead of red meats; and cooking from basic ingredients. Responses were collected on a 5-point response format scale (1 = not at all confident; 5 = extremely confident) and mean scale scores were calculated for data analyses. High mean scale scores indicated high self-efficacy for consuming a healthy diet.

b. Attitude

Attitude toward healthy eating was assessed using a single item analogous to one used in the National Health and Nutrition Examination Survey (NHANES) Flexible Consumer
Behavior Module. Respondents were asked to indicate their level of agreement to the following statement, “It is important to me that the foods I usually eat are healthy.” Responses were collected on a 5-point response format scale (1 = strongly disagree; 5 = strongly agree) and higher scores indicated a more positive attitude toward healthy eating.

c. Cooking confidence

A 10-item survey instrument was used to assess respondents’ confidence in performing cooking activities at home using basic preparation and techniques, including fruit and vegetable preparation. Examples of basic cooking preparation and techniques evaluated in the instrument include basic knife skills; steaming, sautéing, grilling, stewing, and baking food; preparing green vegetables (e.g., spinach), root vegetables (e.g. potatoes, carrots), and fruit; and using herbs and spices. Responses were collected on a 5-point response format scale (1 = not at all confident; 5 = extremely confident) and mean scale scores were calculated for data analyses. High mean scale scores indicated high confidence in cooking preparation and techniques.

Social environment level

a. Family and peer support

The Social Support and Eating Habits Survey was used to assess respondents’ social and familial support for healthy eating. The survey is a 10-item instrument containing four subscales to assess social support: family encouragement, family discouragement, peer encouragement, and peer discouragement. Respondents were asked to rate how often family and peers exhibited encouraging or discouraging actions regarding healthy eating on a 5-point response format scale (1 = never; 5 = very often). Separate mean scale scores
were calculated for family and peer support for data analyses. High mean scale scores indicated greater family and peer support for healthy eating.177

b. Cultural influences

Cultural influences on diet and eating habits were measured using adapted questions from the Multidimensional Home Environment Scale (MHES).178 Respondents were asked about their sense of belonging to a cultural, ethnic, or religious group and the importance it had on the foods they eat. Responses were collected using a 5-point response format scale (1 = strongly disagree; 5 = strongly agree) and mean scale scores were calculated for data analyses. High mean scale scores indicated a high sense of cultural influence on dietary behavior.

Physical environment level

a. Home food environment

Home food environment was measured using an adapted question from the MHES.178 Respondents were asked about regular availability of fresh produce, soft drinks, candy or chocolate, and potato chips or salted snacks in their household. Responses were collected using a 5-point response format scale (1 = strongly disagree; 5 = strongly agree). Scores for unhealthy food items (e.g., soft drinks, candy, chocolate, chips, and salted snacks) were reverse coded, allowing mean scale scores to be calculated for data analyses. Higher mean scale scores indicated a healthier home food environment.

b. Community availability and accessibility

The availability and accessibility of healthy food options in the local community was assessed using survey items from the Perceived Nutrition Environment Measures Survey (NEMS-P).179 Local community was defined as the area within a 30-minute walk or 15-
minute drive from the respondent’s home. Respondents were asked to indicate their level of agreement with statements regarding the accessibility, variety, and quality of fresh produce and low-fat options in their local community using a 5-point response format scale (1 = strongly disagree; 5 = strongly agree). Mean scale scores were calculated for data analyses, and higher scores indicated better perceived accessibility and availability of healthy food in the local community.

c. Affordability of healthy food

The perceived affordability of healthy food options was assessed using two adapted survey items developed by Echeverria et al. (2004). Respondents were asked to indicate the perceived expensiveness of fresh produce at the store where they purchase most of their food (1 = very inexpensive; 5 = very expensive) and whether expense impacts their purchasing of fresh produce (1 = never; 5 = always). Mean scale scores were calculated for data analyses. Higher mean scale scores indicated greater perceived expensiveness of healthy food items.

Chronic health conditions

Information about diet-related chronic health conditions was collected as part of the screening process. Dichotomous response questions (i.e., yes/no) were used to elicit physician diagnoses regarding seven conditions from respondents. The survey items were obtained from the 2020 Behavioral Risk Factor Surveillance System (BRFSS) questionnaire, which collects data from U.S. residents regarding health-related behaviors, conditions, and use of services. The diet-related chronic conditions included hypertension, hypercholesterolemia, coronary artery disease, stroke, obesity, pre-diabetes, and type 2 diabetes. Respondents diagnosed with at least one chronic condition were included in the study. Furthermore, the number of diet-related chronic conditions
was included in data analyses as a covariate in the prediction of profile membership.

**Likelihood to participate in food as medicine programs**

The likelihood to participate in a food as medicine program was collected as part of the screening process using a single survey item. Respondents were asked to indicate their likelihood to participate in a food as medicine program using a 7-point response format scale (1 = extremely unlikely to 7 = extremely likely). A brief description of food as medicine programs was presented to participants prior to assessment of their likelihood to participate to ensure understanding of programs was consistent among all respondents. Respondents that rated their likelihood to participate as neutral or greater (i.e., response scale score of 3 or more) were included in the study. Furthermore, likelihood to participate was utilized as a distal outcome to examine differences among the identified latent profiles. Item responses were dichotomized for data analyses (lower likelihood = 0; higher likelihood = 1). Respondents who selected very likely (scale score = 6) or extremely likely (scale score = 7) were recoded into the higher likelihood group.

**Food security**

The Six-Item Short Form Food Security questionnaire was used to assess household food security among respondents. Respondents were asked about their food situation in the last 30 days, which included affording to eat a balanced meal, purchasing more of foods that did not last, cutting or skipping meals, eating less than they should, and being hungry but not eating. A raw scale score (range 0 to 6) was calculated to determine respondents’ food security status, which was subsequently dichotomized for data analyses (food secure = 0; food insecure = 1). Respondents assigned a raw scale score of two (2) or more were recoded as food insecure. Food security status was used as a covariate in data analysis for the prediction of profile membership.
Sociodemographic characteristics

Sociodemographic characteristics were gathered using adapted questions from the 2020 BRFFS demographic core section and used as covariates in the prediction of profile membership. The following sociodemographic characteristics from were collected: 1. Age in years; 2. Gender; 3. Hispanic, Latino/a, or Spanish origin; 4. Race; 5. Marital or relationship status; 6. Level of education; 7. Annual household income; 8. Employment status; 9. Healthcare insurance status; 10. Housing arrangement; 11. Household size; 12. Number of children in household; 13. Area of residence; 14. Access to transportation; and 15. Dietary regimen or restrictions.

Data Analysis

Descriptive statistics were performed to summarize sociodemographic characteristics, chronic health conditions, and food security status for the entire study sample. Continuous variables were assessed using means and standard deviations; categorical variables were assessed using frequencies and percentages. Scores for each scale used as a latent profile predictor were presented using means and standard deviation. All descriptive statistics were conducted using IBM Statistical Package for the Social Sciences (SPSS) Statistics, version 27.

Latent profile analysis (LPA) was used to identify latent subgroups of individuals based on the socio-ecological factors identified from previous literature. This statistical method utilizes patient-centered mixture modeling to identify latent subpopulations within a sample based on patterns of responses to observed continuous indicator variables. The following SE variables were used as indicators to identify latent profiles of individuals in this study: self-efficacy, attitude, cooking confidence, family support, peer support, cultural influence, home food environment, community availability and accessibility, and affordability of healthy food. Each indicator variable was treated continuously by calculating mean scales scores. Since the data were treated
continuously, maximum likelihood estimation with robust standard errors was used in statistical analyses.\textsuperscript{174}

A stepwise approach was used to determine the optimal number of latent profiles that best characterized the data and sample. This process involved comparing a sequence of models beginning with a one-profile model followed by subsequent models with one additional profile at a time, until an optimal model was identified.\textsuperscript{174,186} In each sequence, the models were compared based on statistical and substantive criteria, and theoretical interpretability to determine the optimal model. The chi-square ($\chi^2$) difference test was used as an initial indicator to determine if the more complex model ($k$ profiles) was statistically better than the preceding, less complex model ($k - 1$ profiles) at an alpha level of 0.05.\textsuperscript{187} Additional tests and fit indices were utilized to assess the relative fit of each model to help identify the optimal model. The Adjusted Lo-Mendell-Rubin (Adjusted LMR) likelihood ratio test and bootstrapped likelihood ratio test (BLRT) was assessed to compare relative model fit between neighboring models.\textsuperscript{173,174,188} For each test, a non-significant ($p > 0.05$) result for the more complex model ($k$ profiles) indicates the less complex model ($k - 1$ profiles) is superior and should be retained.\textsuperscript{173,174} Akaike Information Criterion (AIC) and sample size-adjusted Bayesian Information Criterion (SABIC) were used to evaluate relative fit between models as well, with lower values indicating the better fitting model.\textsuperscript{173,174,189,190} A composite entropy statistic was used to determine the overall ability of each model to produce well-separated profiles.\textsuperscript{174,191} A higher entropy statistic (up to perfect classification at value 1) indicates better fit, thus a cut-off of 0.80 or higher was used to determine satisfactory distinction between profiles.\textsuperscript{174,192} Posterior classification probabilities were used to determine the probability that cases were appropriately classified into the correct profile, with a probability of 0.80 or higher indicating adequate accuracy.\textsuperscript{174,187} Lastly, size and interpretability of profiles were evaluated to
ensure understanding of each subgroup in the optimal model and facilitate subsequent analyses of distal outcomes.\textsuperscript{174}

Once the optimal model with the appropriate number of profiles was identified, predictors of profile membership were examined using an approach developed by Vermunt (2010).\textsuperscript{193} This process involves identifying the optimal model, determining the most likely profile variable from the latent class posterior distribution, and including the most likely profile variable as an indicator with the study covariates.\textsuperscript{194} The statistical software used for data analyses has automated this approach with the R3Step command, which was used in this study to assess predictors of latent profile membership without altering profile structure.\textsuperscript{194,195} The following covariates were utilized to examine predictors of latent profile membership: age, gender, ethnicity, race, marital status, level of education, annual household income, employment status, health insurance status, homeownership, rurality, vehicle ownership, household size, number of children, number of chronic conditions, and food security status. A multinomial logistic regression analysis was conducted with all covariates included at alpha level of 0.05, and the adjusted odds ratios with 95\% confidence intervals and $p$-values were reported.

The association of latent profile membership with likelihood to participate, adjusting for covariates, were examined using an approach developed by Bolck, Croon, and Hagenaars (2004).\textsuperscript{196} The BCH method is recommended for complex latent class models examining count or continuous distal outcome variables in which covariates affect the outcome and latent class variables.\textsuperscript{197} First, the optimal model identified from the latent profile indicators was utilized to generate BCH weights, which are obtained from the inverse matrix of the classification probabilities.\textsuperscript{197} Then a general auxiliary model conditional on the latent profile variable was estimated using the generated BCH weights, which prevents profile shift from occurring.\textsuperscript{197} All
categorical covariates were centered prior to this final step. A multivariable linear regression analysis was conducted in the final step to assess the association between latent profile membership and the dichotomized likelihood to participate while adjusting for covariates. All LPA model classification and subsequent analyses were performed using Mplus Version 8.8 software package. A two-sided \( p \)-value of 0.05 was used to determine statistical significance for all analyses and 95% confidence intervals were reported when possible.

2.4 Results

Sample characteristics

A total of 3,587 individuals interacted with the survey invitation distributed by Qualtrics, which resulted in 2,680 respondents beginning the survey. Of those entrants, 1,006 were excluded for not completing the entire survey; 501 were excluded for having no diet-related chronic conditions; 190 were excluded for indicating they were unlikely to participate in a food as medicine program; 14 were excluded for being under 18 years of age; 14 were excluded for not living in the U.S.; 237 were excluded for not passing the attention check; 63 were excluded for speeding; and 56 were excluded for beginning the survey on a mobile device. Thus, 599 completed responses were included for data analyses in the study (22.4% response rate).

The sample demographic and household characteristics are presented in Table 2.1. The final sample of 599 respondents was representative of the U.S. population based on gender (51.3% female), race (76.0% White; 13.0% Black; 6.2% Asian or Pacific Islander), ethnicity (18.0% Hispanic), and had a mean age of 48.5 years (SD± 17.8). Most respondents were college graduates (51.1%), married (50.8%), employed part- or full-time (56.3%), and had private health insurance (45.1%). The mean number of diet-related chronic conditions was 2.6 (SD± 1.4) and 47.6% of respondents were determined to be food insecure. Among household characteristics, most
respondents had an annual household income of $50,000 or greater (57.9%), were homeowners (63.4%), and lived in urban or suburban locations (75.1%). The mean household size was 2.7 (SD± 1.4), with an average of 0.6 (SD± 0.9) children per household.

Table 2.1 Demographic and household characteristics of the study sample

<table>
<thead>
<tr>
<th>Characteristic (N = 599)</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (SD)</td>
<td>48.5 (17.8)</td>
</tr>
<tr>
<td>Age groups</td>
<td></td>
</tr>
<tr>
<td>18 – 34 years</td>
<td>180 (30.1)</td>
</tr>
<tr>
<td>35 – 49 years</td>
<td>147 (24.5)</td>
</tr>
<tr>
<td>50 – 64 years</td>
<td>106 (17.7)</td>
</tr>
<tr>
<td>65 years and older</td>
<td>166 (27.7)</td>
</tr>
<tr>
<td>Female</td>
<td>307 (51.3)</td>
</tr>
<tr>
<td>Hispanic Latino/a, or Spanish Ethnicity</td>
<td>108 (18.0)</td>
</tr>
<tr>
<td>Mexican</td>
<td>54 (9.0)</td>
</tr>
<tr>
<td>Puerto Rican</td>
<td>24 (4.0)</td>
</tr>
<tr>
<td>Cuban</td>
<td>8 (1.3)</td>
</tr>
<tr>
<td>Other</td>
<td>22 (3.7)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>455 (76.0)</td>
</tr>
<tr>
<td>Black</td>
<td>78 (13.0)</td>
</tr>
<tr>
<td>American Indian</td>
<td>9 (1.5)</td>
</tr>
<tr>
<td>Asian or Pacific Islander</td>
<td>37 (6.2)</td>
</tr>
<tr>
<td>Other</td>
<td>20 (3.3)</td>
</tr>
<tr>
<td>Highest level of education</td>
<td></td>
</tr>
<tr>
<td>Elementary (1&lt;sup&gt;st&lt;/sup&gt;-8&lt;sup&gt;th&lt;/sup&gt;)</td>
<td>1 (0.2)</td>
</tr>
<tr>
<td>Some high school (9&lt;sup&gt;th&lt;/sup&gt;-11&lt;sup&gt;th&lt;/sup&gt;)</td>
<td>4 (0.7)</td>
</tr>
<tr>
<td>High school graduate (12&lt;sup&gt;th&lt;/sup&gt; or GED)</td>
<td>101 (16.9)</td>
</tr>
<tr>
<td>Some college or technical school (1-3 years)</td>
<td>187 (31.2)</td>
</tr>
<tr>
<td>College graduate (4 or more years)</td>
<td>202 (33.7)</td>
</tr>
<tr>
<td>Advanced degree graduate (e.g., M.S., Ph.D.)</td>
<td>104 (17.4)</td>
</tr>
<tr>
<td>Relationship status</td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>304 (50.8)</td>
</tr>
<tr>
<td>Divorced</td>
<td>54 (9.0)</td>
</tr>
<tr>
<td>Widowed</td>
<td>26 (4.3)</td>
</tr>
<tr>
<td>Single/never married</td>
<td>168 (28.0)</td>
</tr>
<tr>
<td>Separated</td>
<td>5 (0.8)</td>
</tr>
<tr>
<td>Unmarried couple</td>
<td>42 (7.0)</td>
</tr>
<tr>
<td>Characteristic (N = 599)</td>
<td>n (%)</td>
</tr>
<tr>
<td>-------------------------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td><strong>Employment status, n (%)</strong></td>
<td></td>
</tr>
<tr>
<td>Employed full-time (&gt; 30 hours/week)</td>
<td>285 (47.6)</td>
</tr>
<tr>
<td>Employed part-time (&lt; 30 hours/week)</td>
<td>52 (8.7)</td>
</tr>
<tr>
<td>Unemployed for less than 1 year</td>
<td>13 (2.2)</td>
</tr>
<tr>
<td>Unemployed for more than 1 year</td>
<td>21 (3.5)</td>
</tr>
<tr>
<td>Student</td>
<td>17 (2.8)</td>
</tr>
<tr>
<td>Retired</td>
<td>143 (23.9)</td>
</tr>
<tr>
<td>Stay at home parent or homemaker</td>
<td>33 (5.5)</td>
</tr>
<tr>
<td>Disabled or unable to work</td>
<td>35 (5.8)</td>
</tr>
<tr>
<td><strong>Health insurance status</strong></td>
<td></td>
</tr>
<tr>
<td>Insurance through employer</td>
<td>225 (37.6)</td>
</tr>
<tr>
<td>Insurance through marketplace</td>
<td>45 (7.5)</td>
</tr>
<tr>
<td>Medicare</td>
<td>184 (30.7)</td>
</tr>
<tr>
<td>Medicaid</td>
<td>79 (13.2)</td>
</tr>
<tr>
<td>Medicare and Medicaid dual enrollment</td>
<td>24 (4.0)</td>
</tr>
<tr>
<td>TRICARE, VA, or other military insurance</td>
<td>15 (2.5)</td>
</tr>
<tr>
<td>Indian Health Services</td>
<td>1 (0.2)</td>
</tr>
<tr>
<td>No health insurance</td>
<td>21 (3.5)</td>
</tr>
<tr>
<td>Other</td>
<td>5 (0.8)</td>
</tr>
<tr>
<td><strong>Mean number of diet-related chronic conditions (SD)</strong></td>
<td>2.6 (1.4)</td>
</tr>
<tr>
<td><strong>Mean household size (SD)</strong></td>
<td>2.7 (1.4)</td>
</tr>
<tr>
<td><strong>Mean number of children per household (SD)</strong></td>
<td>0.6 (0.9)</td>
</tr>
<tr>
<td><strong>Annual household income, n (%)</strong></td>
<td></td>
</tr>
<tr>
<td>&lt; $10,000</td>
<td>22 (3.7)</td>
</tr>
<tr>
<td>$10,000 – $14,999</td>
<td>20 (3.3)</td>
</tr>
<tr>
<td>$15,000 – $19,999</td>
<td>24 (4.0)</td>
</tr>
<tr>
<td>$20,000 – $24,999</td>
<td>33 (5.5)</td>
</tr>
<tr>
<td>$25,000 – $34,999</td>
<td>58 (9.7)</td>
</tr>
<tr>
<td>$35,000 – $49,999</td>
<td>95 (15.9)</td>
</tr>
<tr>
<td>$50,000 – $74,999</td>
<td>160 (26.7)</td>
</tr>
<tr>
<td>$75,000 – $99,999</td>
<td>75 (12.5)</td>
</tr>
<tr>
<td>$100,000 – $149,999</td>
<td>75 (12.5)</td>
</tr>
<tr>
<td>≥ $150,000</td>
<td>37 (6.2)</td>
</tr>
<tr>
<td><strong>Housing arrangement</strong></td>
<td></td>
</tr>
<tr>
<td>Homeownership</td>
<td>380 (63.4)</td>
</tr>
<tr>
<td>Rent residence</td>
<td>181 (30.2)</td>
</tr>
<tr>
<td>Other arrangements (e.g., group home)</td>
<td>38 (6.3)</td>
</tr>
</tbody>
</table>
Table 2.1 (cont.) Demographic and household characteristics of the study sample

<table>
<thead>
<tr>
<th>Characteristic (N = 599)</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential location</td>
<td></td>
</tr>
<tr>
<td>Urban or inner-city</td>
<td>199 (33.2)</td>
</tr>
<tr>
<td>Suburban</td>
<td>251 (41.9)</td>
</tr>
<tr>
<td>Town or village</td>
<td>37 (6.2)</td>
</tr>
<tr>
<td>Rural or countryside</td>
<td>112 (18.7)</td>
</tr>
<tr>
<td>Primary mode of transportation</td>
<td></td>
</tr>
<tr>
<td>Personal vehicle</td>
<td>505 (84.3)</td>
</tr>
<tr>
<td>Ride sharing with friends or family</td>
<td>28 (4.7)</td>
</tr>
<tr>
<td>Public transit</td>
<td>27 (4.5)</td>
</tr>
<tr>
<td>Community para-transit</td>
<td>4 (0.7)</td>
</tr>
<tr>
<td>Taxi or ride-sharing service (e.g., Uber or Lyft)</td>
<td>9 (1.5)</td>
</tr>
<tr>
<td>Bicycle</td>
<td>1 (0.2)</td>
</tr>
<tr>
<td>Walking</td>
<td>25 (4.2)</td>
</tr>
<tr>
<td>Food insecure</td>
<td>285 (47.6)</td>
</tr>
<tr>
<td>Dietary regimen or restrictions</td>
<td></td>
</tr>
<tr>
<td>Vegan</td>
<td>38 (6.3)</td>
</tr>
<tr>
<td>Vegetarian</td>
<td>37 (6.2)</td>
</tr>
<tr>
<td>Pescatarian</td>
<td>39 (6.5)</td>
</tr>
<tr>
<td>No dietary regimens or restrictions</td>
<td>485 (81.0)</td>
</tr>
</tbody>
</table>

**Latent profile classification**

A summary of the model fit indices and statistics for the latent profile analysis is provided in Table 2.2. Initial comparisons utilizing the AIC and SABIC fit indices indicated progressive improvement as the models became more complex, reaching the lowest values in the six-profile model. Additional examination of the fit statistics between the five- and six-profile models revealed there was not substantial improvement with the more complex model based on the non-significant adjusted LMR test ($p = 0.06$). Further evaluation of the five-profile model suggests a significant improvement from the less complex, four-profile model based on the adjusted LMR ($p = 0.047$) and BLRT ($p < 0.001$). The entropy statistic also indicated the five-profile model had better accuracy of classification compared to the four-profile model (0.861 vs. 0.839, respectively).
Table 2.2 Summary of Latent Profile Analysis Model Fit Indices and Statistics

<table>
<thead>
<tr>
<th>Model</th>
<th>Log-likelihood</th>
<th>AIC</th>
<th>BIC</th>
<th>SABIC</th>
<th>Entropy</th>
<th>Smallest class %</th>
<th>Adjusted LMR</th>
<th>BLRT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p-value</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>−6,606.60</td>
<td>13,249.20</td>
<td>13,328.32</td>
<td>13,271.17</td>
<td>−</td>
<td>−</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>−6,206.38</td>
<td>12,468.77</td>
<td>12,591.84</td>
<td>12,502.94</td>
<td>0.842</td>
<td>33.8</td>
<td>&lt;0.001</td>
<td>2 &gt; 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>−5,984.25</td>
<td>12,044.51</td>
<td>12,211.53</td>
<td>12,090.89</td>
<td>0.818</td>
<td>27.3</td>
<td>&lt;0.001</td>
<td>3 &gt; 2</td>
</tr>
<tr>
<td>4</td>
<td>−5,847.07</td>
<td>11,790.15</td>
<td>12,001.12</td>
<td>11,848.73</td>
<td>0.839</td>
<td>19.9</td>
<td>&lt;0.001</td>
<td>4 &gt; 3</td>
</tr>
<tr>
<td>5</td>
<td>−5,777.28</td>
<td>11,670.56</td>
<td>11,925.48</td>
<td>11,741.35</td>
<td>0.861</td>
<td>3.3</td>
<td>0.047</td>
<td>5 &gt; 4</td>
</tr>
<tr>
<td>6</td>
<td>−5,713.68</td>
<td>11,563.37</td>
<td>11,862.24</td>
<td>11,646.36</td>
<td>0.839</td>
<td>3.1</td>
<td>0.060</td>
<td>6 &lt; 5</td>
</tr>
</tbody>
</table>

Note. N = 599; Values representing the optimal number of latent profiles are given in boldface. The LMR test and BLRT compare the current model with \( k - 1 \) model. LPA = Latent Profile Analysis; AIC = Akaike’s Information Criteria; BIC = Bayesian Information Criteria; SABIC = Sample-Adjusted BIC; LMR = Lo-Mendell-Rubin test; BLRT = Bootstrapped likelihood ratio test.

Table 2.3 Posterior Classification Probabilities for the Four-Profile Model

<table>
<thead>
<tr>
<th>Latent Profile</th>
<th>Most Likely Profile Membership</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Profile 1</td>
<td>0.935</td>
</tr>
<tr>
<td>Profile 2</td>
<td>0.017</td>
</tr>
<tr>
<td>Profile 3</td>
<td>0.060</td>
</tr>
<tr>
<td>Profile 4</td>
<td>0.078</td>
</tr>
</tbody>
</table>

Note. Values representing cases appropriately classified into the correct profile are given in boldface; values above 0.80 indicate high classification probabilities.
However, the smallest class proportion in the five-profile model was 3.3% compared to 19.9% in the four-profile model potentially limiting interpretability in subsequent distal outcome analyses. As such, the four-profile model was chosen as the optimal model for this study. Posterior classification probabilities (Table 2.3) for the four-profile model were 0.935, 0.953, 0.845, and 0.896, respectively, indicating the chosen model accurately and appropriately classified cases into the correct profile.

Figure 2.1 shows the mean $z$-score plot of the indicators used in the analysis from the four-profile model. The major differentiation in SE factors between profiles occurred within the individual- and social environment-levels. Profile 1 scored approximately 0.5 standard deviations (SD) above sample mean for each individual-level indicator, and 0.5 SD below the mean for support indicators in social environment-level. Profile 2 had mean scores between 0.5 and 1.5 SD above the mean for all indicators in the two levels. Profile 3 scores were approximately 0.5 standard deviations (SD) below sample mean for all individual-level indicators, and 0.5 SD above the mean for support indicators. Lastly, Profile 4 had scores approximately 1 SD below the mean for all indicators in the two levels. Mean scores for the physical environment-level indicators were $\pm 0.5$ SD or less from the mean for all profiles.

The mean scale scores for each profile in the four-profile model are presented in Table 2.4. Based on the most likely latent profile membership, Profile 1 (*Socially-Limited Capable (SLC)* group) contained the largest number of members ($n = 234$; 39.1%). This group had high individual-level, low social environment-level, and high physical environment-level indicators for healthy environment-level, and high physical environment-level indicators for healthy dietary behavior and consumption. Among individual-level factors, the SLC group had the highest mean scale score for cooking confidence ($M = 4.293$), and the second highest mean scale score for self-efficacy.
The mean scale scores for the social environment-level indicators were 2.332 (SD± 0.53) for family support, 2.049 (SD± 0.53) for peer support, and 3.121 (SD± 0.82) for cultural influence. In terms of physical environment-level indicators, SLC had the highest mean scale scores of all profiles for home food environment (M = 3.449) and community availability and accessibility (M = 4.453) but had the lowest score for perceived affordability of healthy food (M = 3.260).
Table 2.4 Four-Profile Model Results

<table>
<thead>
<tr>
<th>Indicator Variables</th>
<th>Profile 1: Socially-Limited Capable</th>
<th>Profile 2: High Propensity Capable</th>
<th>Profile 3: Disengaged Capable</th>
<th>Profile 4: Low Propensity Vulnerable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 234; 39.1%)</td>
<td>(n = 129; 21.5%)</td>
<td>(n = 118; 19.7%)</td>
<td>(n = 118; 19.7%)</td>
</tr>
<tr>
<td>Individual-level socio-ecological indicators</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy eating self-efficacy</td>
<td>3.814 (0.52)</td>
<td><strong>4.100 (0.52)</strong></td>
<td>3.073 (0.52)</td>
<td>2.751 (0.52)</td>
</tr>
<tr>
<td>Attitude toward healthy eating</td>
<td>4.281 (0.63)</td>
<td><strong>4.384 (0.63)</strong></td>
<td>3.474 (0.63)</td>
<td>3.126 (0.63)</td>
</tr>
<tr>
<td>Cooking confidence</td>
<td><strong>4.293 (0.61)</strong></td>
<td>4.253 (0.61)</td>
<td>3.487 (0.61)</td>
<td>3.309 (0.61)</td>
</tr>
<tr>
<td>Social environment-level socio-ecological indicators</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family support for healthy eating</td>
<td>2.332 (0.53)</td>
<td><strong>3.952 (0.53)</strong></td>
<td>3.057 (0.53)</td>
<td>1.871 (0.53)</td>
</tr>
<tr>
<td>Peer support for healthy eating</td>
<td>2.049 (0.53)</td>
<td><strong>3.892 (0.53)</strong></td>
<td>2.976 (0.53)</td>
<td>1.563 (0.53)</td>
</tr>
<tr>
<td>Cultural influence on diet</td>
<td>3.121 (0.82)</td>
<td><strong>4.132 (0.82)</strong></td>
<td>3.219 (0.82)</td>
<td>2.390 (0.82)</td>
</tr>
<tr>
<td>Physical environment-level socio-ecological indicators</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home food environment</td>
<td><strong>3.449 (0.63)</strong></td>
<td>2.920 (0.63)</td>
<td>2.809 (0.63)</td>
<td>2.961 (0.63)</td>
</tr>
<tr>
<td>Community availability and accessibility</td>
<td><strong>4.453 (0.74)</strong></td>
<td>4.243 (0.74)</td>
<td>3.755 (0.74)</td>
<td>3.871 (0.74)</td>
</tr>
<tr>
<td>Affordability of healthy food</td>
<td>3.260 (0.75)</td>
<td><strong>3.963 (0.75)</strong></td>
<td>3.703 (0.75)</td>
<td>3.355 (0.75)</td>
</tr>
</tbody>
</table>

*Note.* N = 599. Values representing highest positive response are given in boldface. All scores are mean scale scores assessed using a 5-point response scale. Means and standard deviations for variables across all profiles: self-efficacy M = 3.510 (SD = 0.73), attitude M = 3.907 (SD = 0.81), cooking confidence M = 3.923 (SD = 0.75), family support M = 2.731 (SD = 0.91), peer support M = 2.532 (SD = 0.99), cultural influence M = 3.209 (SD = 1.00), home food environment M = 3.109 (SD = 0.69), availability and accessibility M = 4.149 (SD = 0.80), affordability M = 3.518 (SD = 0.80).
Profile 2 (*High Propensity Capable (HPC) group*) was the second largest group with 129 members (21.5%). They had high individual- and social environment-level indicators, and moderate physical environment-level indicators. Compared to other profiles, the *HPC* group had the highest mean scale scores for self-efficacy (M = 4.100), attitude (M = 4.384), family support (M = 3.952), peer support (M = 3.892), cultural influence (4.132), and perceived affordability of healthy food (M = 3.963). The remaining individual-level indicator, cooking confidence (M = 4.253), was the second highest mean scale across all profiles. The *HPC* group also had a high mean scale score for community availability and accessibility (M = 4.243) but moderate mean scale score for home food environment (M = 2.920).

Profile 3 (*Disengaged Capable (DC) group*) and Profile 4 (*Low Propensity Vulnerable (LPV) group*) had the fewest number of members with 118 (19.7%). The *DC* group had low to moderate individual-, social environment-, and physical environment-level indicators. Mean scale scores for the individual-level indicators in this group were lower than the *SLC* and *HPC* groups at 3.073 (SD± 0.52) for self-efficacy, 3.474 (SD± 0.63) for attitude, and 3.487 (SD± 0.61) for cooking confidence. For social environment-level indicators, the *DC* group had the second highest mean scale scores across all groups. The mean scale scores were 3.057 (SD± 0.53) for family support, 2.976 (SD± 0.53) for peer support, and 3.219 (SD± 0.82) for cultural influence. Lastly, the *DC* group had moderate mean scale scores for community availability and accessibility (M = 3.755) and perceived affordability (M = 3.703), and the lowest mean scale score of all groups for home food environment (M = 2.809).

The *LPV* group had low individual- and social environment-level indicators, and moderate physical environment-level indicators for healthy dietary behavior and consumption. The *LPV* group had the lowest mean scale scores across all groups for self-efficacy (M = 2.751), attitude (M
= 3.126), cooking confidence (M = 3.309), family support (M = 1.871), peer support (M = 1.563), and cultural influence (M = 2.390). For physical environment-level indicators, mean scale scores for home food environment (M = 2.961) in the LPV group was comparable to the scores for the HPC and DC groups. The mean scale scores for community availability and accessibility and perceived affordability were 3.871 (SD ± 0.74) and 3.355 (SD ± 0.75), respectively, which were the second lowest compared to the other groups.

Among the four groups, the SLC group exhibited the greatest number of high positive responses overall. The group had two of the highest mean scale scores among the individual-level indicators, all the highest scores for social environment-level indicators, and one in the physical environment-level indicators. Conversely, the LPV group had all the lowest scores for individual- and social environment-level indicators, and the second lowest scores for all physical environment-level indicators. The other two groups, HPC and DC, were generally in middle ground in terms of mean scale scores for the nine different indicators with several exceptions as previously discussed.

**Predictors of latent profile membership**

The results of multinomial logistic regression analysis conducted to examine predictors of latent profile membership are presented in Table 2.5. The LPV group was used as the reference group for comparison in the table. Relationship status was the only significant differentiator in membership between the SLC and LPV groups. Members of the SLC group had significantly lower odds of being single or never married (OR = 0.20 [95% CI: 0.05–0.76], p = 0.018) compared with those who were married.
Table 2.5 Predictors of latent profile membership

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>SLC vs. LPV</th>
<th>HPC vs. LPV</th>
<th>DC vs. LPV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odds Ratio</td>
<td>95% LLCI</td>
<td>95% ULCI</td>
</tr>
<tr>
<td>Age&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35 – 49 years</td>
<td>0.34</td>
<td>0.09</td>
<td>1.23</td>
</tr>
<tr>
<td>50 – 64 years</td>
<td>1.03</td>
<td>0.26</td>
<td>4.01</td>
</tr>
<tr>
<td>65 years or older</td>
<td>2.20</td>
<td>0.23</td>
<td>20.71</td>
</tr>
<tr>
<td>Female&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.92</td>
<td>0.81</td>
<td>4.55</td>
</tr>
<tr>
<td>Hispanic or Spanish Ethnicity&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.83</td>
<td>0.45</td>
<td>7.34</td>
</tr>
<tr>
<td>Race&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>2.42</td>
<td>0.84</td>
<td>6.98</td>
</tr>
<tr>
<td>Other</td>
<td>1.64</td>
<td>0.50</td>
<td>5.45</td>
</tr>
<tr>
<td>Education&lt;sup&gt;e&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some college or technical school</td>
<td>1.09</td>
<td>0.42</td>
<td>2.84</td>
</tr>
<tr>
<td>College graduate</td>
<td>1.39</td>
<td>0.43</td>
<td>4.55</td>
</tr>
<tr>
<td>Advanced degree graduate</td>
<td>3.16</td>
<td>0.92</td>
<td>10.80</td>
</tr>
<tr>
<td>Relationship status&lt;sup&gt;f&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single/never married</td>
<td>0.20</td>
<td>0.05</td>
<td>0.76</td>
</tr>
<tr>
<td>Divorced/Widowed/Separated</td>
<td>0.54</td>
<td>0.19</td>
<td>1.60</td>
</tr>
<tr>
<td>Employment&lt;sup&gt;g&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployed/Student/Homemaker/Disabled</td>
<td>0.82</td>
<td>0.31</td>
<td>2.18</td>
</tr>
<tr>
<td>Retired</td>
<td>0.28</td>
<td>0.04</td>
<td>2.19</td>
</tr>
</tbody>
</table>

Note. N = 575. LLCI = Lower Level Confidence Interval; ULCI = Upper Level Confidence Interval. Statistically significant odds ratios representing prediction of latent profile membership are given in boldface; *Statistically significant at a p-value £ 0.05; **Statistically significant at a p-value £ 0.001; a 18 – 34 years used as the reference category; b No used as the reference category; c No used as the reference category; d White used as the reference category; e High school or lower used as the reference category; f Married/unmarried couple used as the reference category; g Employed used as the reference category.
Table 2.5 (cont.) Predictors of latent profile membership

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>SLC vs. LPV</th>
<th>HPC vs. LPV</th>
<th>DC vs. LPV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odds Ratio</td>
<td>95% LLCI</td>
<td>95% ULCI</td>
</tr>
<tr>
<td>Insurance status^h</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medicare</td>
<td>1.56</td>
<td>0.47</td>
<td>5.14</td>
</tr>
<tr>
<td>Medicaid</td>
<td>0.72</td>
<td>0.15</td>
<td>3.52</td>
</tr>
<tr>
<td>Other (Dual enrollment, TRICARE, IHS)</td>
<td>0.81</td>
<td>0.20</td>
<td>3.33</td>
</tr>
<tr>
<td>No health insurance</td>
<td>0.32</td>
<td>0.01</td>
<td>21.60</td>
</tr>
<tr>
<td>Number of chronic conditions</td>
<td>1.05</td>
<td>0.75</td>
<td>1.47</td>
</tr>
<tr>
<td>Household size</td>
<td>0.76</td>
<td>0.43</td>
<td>1.33</td>
</tr>
<tr>
<td>Number of children in household</td>
<td>1.97</td>
<td>0.78</td>
<td>4.99</td>
</tr>
<tr>
<td>Annual household income^i</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;$35,000 – &lt;$49,999</td>
<td>0.36</td>
<td>0.09</td>
<td>1.50</td>
</tr>
<tr>
<td>$50,000 – $74,999</td>
<td>0.67</td>
<td>0.17</td>
<td>2.57</td>
</tr>
<tr>
<td>$75,000 – $99,999</td>
<td>0.93</td>
<td>0.18</td>
<td>4.88</td>
</tr>
<tr>
<td>≥ $100,000</td>
<td>1.24</td>
<td>0.24</td>
<td>6.29</td>
</tr>
<tr>
<td>Homeownership^j</td>
<td>0.67</td>
<td>0.26</td>
<td>1.73</td>
</tr>
<tr>
<td>Rurality^k</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suburban</td>
<td>1.40</td>
<td>0.57</td>
<td>3.48</td>
</tr>
<tr>
<td>Rural</td>
<td>1.26</td>
<td>0.49</td>
<td>3.21</td>
</tr>
<tr>
<td>Personal vehicle ownership^l</td>
<td>0.86</td>
<td>0.32</td>
<td>2.31</td>
</tr>
<tr>
<td>Food insecure^m</td>
<td>0.52</td>
<td>0.21</td>
<td>1.29</td>
</tr>
</tbody>
</table>

Note. N = 575. LLCI = Lower Level Confidence Interval; ULCI = Upper Level Confidence Interval. Statistically significant odds ratios representing prediction of latent profile membership are given in boldface. * Statistically significant at a p-value ≤ 0.05; ** Statistically significant at a p-value ≤ 0.001; # Cell counts for one of the profiles were too small analyses; ^ Private used as the reference category; 1 <$35,000 used as the reference category; ^ No used as the reference category; * Urban used as the reference category; No used as the reference category; ^ No used as the reference category
Age, employment status, the number of chronic conditions, and food security status could differentiate membership in the \textit{HPC} group compared to the \textit{LPV} group. Members of the \textit{HPC} group had significantly lower odds of being between the ages of 50–64 years old (OR = 0.13 [95\% CI: 0.03–0.66], \( p = 0.014 \)) and 65 years or older (OR = 0.03 [95\% CI: 0.00–0.47], \( p = 0.018 \)) compared to 18–34 years old. Members also had significantly lower odds of being a student, homemaker, disabled, or unemployed (OR = 0.15 [95\% CI: 0.03–0.68], \( p = 0.014 \)) compared to employed full-time or part-time. A one-unit increase in the number of diet-related chronic conditions significantly increased the likelihood of being in the \textit{HPC} group compared to the \textit{LPV} group (OR = 1.65 [95\% CI: 1.12–2.42], \( p = 0.011 \)). Lastly, members had significantly higher odds of being Black compared to White (OR = 3.20 [95\% CI: 1.02–9.98], \( p = 0.045 \)) and were 4.49 times more likely to be food insecure ([95\% CI: 0.03–0.68], \( p = 0.014 \)).

The \textit{DC} group was differentiated from the \textit{LPV} group by ethnicity, food security status, the number of chronic conditions, and age. Members of the \textit{DC} group were 5.52 times more likely to be Hispanic, Latino/a, or Spanish Ethnicity ([95\% CI: 1.27–23.93], \( p = 0.022 \)) and 3.48 times more likely to be food insecure ([95\% CI: 1.36–8.92], \( p = 0.009 \)) compared to the \textit{LPV} group. A one-unit increase in the number of diet-related chronic conditions also significantly increased the likelihood of being in the \textit{DC} group (OR = 1.92 [95\% CI: 0.03–0.68], \( p = 0.014 \)). Lastly, members of the \textit{DC} group had significantly lower odds of being between the ages of 50–64 years old (OR = 0.12 [95\% CI: 0.02–0.80], \( p = 0.029 \)) compared to 18–34 years old.

Additional multinomial logistic regression analyses comparing the remaining groups, \textit{SLC} versus \textit{DC}, \textit{HPC} versus \textit{DC}, and \textit{SLC} versus \textit{HPC} are presented in Table 2.7 provided in the Appendix 2 of the dissertation. The \textit{SLC} group was able to be differentiated from the \textit{DC} group based relationship status, annual household income, homeownership, food security status, number
of chronic conditions, and age. Members of the SLC group had significantly lower odds of being single or never married (OR = 0.18 [95% CI: 0.05–0.61], \( p = 0.006 \)) compared to married and having an annual household income between $35,000–$49,999 (OR = 0.22 [95% CI: 0.05–0.97], \( p = 0.045 \)) compared to <$35,000. The SLC group also had significantly lower odds of homeownership (OR = 0.35 [95% CI: 0.13–0.93], \( p = 0.035 \)). Additionally, members were 0.15 times ([95% CI: 0.06–0.40], \( p < 0.001 \)) less likely to be food insecure compared to the DC group.

A one-unit increase in the number of diet-related chronic conditions significantly decreased the likelihood of being in the SLC group (OR = 0.55 [95% CI: 0.39–0.77], \( p = 0.001 \)). Lastly, members of the SLC group had significantly higher odds of being between the ages of 50–64 years old (OR = 8.96 [95% CI: 1.73–46.43], \( p = 0.009 \)) compared to 18–34 years old.

The HPC group could be differentiated from the DC group by relationship status, employment status, and vehicle ownership. Members of the HPC group had significantly lower odds of being single or never married (OR = 0.27 [95% CI: 0.09–0.82], \( p = 0.021 \)) compared to married. Members also had significantly lower odds of being a student, homemaker, disabled, or unemployed (OR = 0.17 [95% CI: 0.03–0.85], \( p = 0.031 \)) compared to employed part- or full-time. Lastly, members of the HPC were 4.90 times ([95% CI: 0.09–0.82], \( p = 0.021 \)) more likely to own a personal vehicle than the DC group.

In the final group comparison, the SLC group was differentiated from the HPC group based on age, employment status, rurality, homeownership, food security status, and number of chronic conditions. Members of the SLC group had significantly higher odds of being between the ages of 50–64 years old (OR = 7.99 [95% CI: 1.97–32.41], \( p = 0.004 \)) and 65 years or older (OR = 72.03 [95% CI: 4.22–1,229.58], \( p = 0.003 \)) compared to 18–34 years old. Members also had significantly higher odds of being a student, homemaker, disabled, or unemployed (OR = 5.56 [95% CI: 1.20–
25.74], p = 0.028) compared with those employed part- or full-time, and living in a rural setting (OR = 3.15 [95% CI: 1.17–8.54], p = 0.024) compared to urban. The SLC group was 0.35 times ([95% CI: 0.13–0.93], p = 0.035) less likely to be homeowners and 0.12 times ([95% CI: 0.05–0.29], p < 0.001) less likely to be food insecure. Lastly, a one-unit increase in the number of diet-related chronic conditions significantly decreased the likelihood of being in the SLC group (OR = 0.64 [95% CI: 0.46–0.89], p = 0.007) compared to the HPC group. A descriptive comparison of the statistically significant sociodemographic differentiators between latent profile groups is presented in Table 2.8 provided in the Appendix 3 of the dissertation.

Association between profile membership and likelihood to participate

Results of the BCH analysis examining the association between latent profile membership and likelihood to participate in food as medicine programs while adjusting for covariates are presented in Table 2.6. The omnibus Wald chi-square test was statistically significant ($\chi^2(3) = 50.969, p < 0.001$) indicating there were differences in likelihood to participate in food as medicine programs across the four groups. Further evaluation of the individual pairwise comparisons revealed a significantly fewer proportion of respondents in the DC group had a higher likelihood of participation compared to the SLC group (0.527 vs. 0.770, $p < 0.001$) and HPC group (0.527 vs. 0.927, $p < 0.001$). Similarly, significantly fewer proportion of respondents in the LPV group had a higher likelihood of participation compared to the SLC group (0.448 vs. 0.770, $p < 0.001$) and HPC group (0.448 vs. 0.927, $p < 0.001$).
Table 2.6 Adjusted Differences Between Class-Specific Means of Distal Outcome Higher Likelihood to Participate

<table>
<thead>
<tr>
<th>Latent Profile</th>
<th>Mean Proportion</th>
<th>SLC</th>
<th>HPC</th>
<th>DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socially-Limited Capable</td>
<td>0.770</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Propensity Capable</td>
<td>0.927</td>
<td>0.157</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disengaged Capable</td>
<td>0.527</td>
<td>−0.243**</td>
<td>−0.400**</td>
<td></td>
</tr>
<tr>
<td>Low Propensity Vulnerable</td>
<td>0.448</td>
<td>−0.322**</td>
<td>−0.479**</td>
<td>−0.079</td>
</tr>
</tbody>
</table>

Note. N = 575. SLC is comparison with the Socially-Limited Capable group; HPC is comparison with the High Propensity Capable group; DC is comparison with the Disengaged Capable group. Likelihood to participate treated as dichotomous variable (0=lower likelihood, 1=higher likelihood); *Statistically significant at a p-value £ 0.05; **Statistically significant at a p-value £ 0.001; Covariates adjusted for include age, gender, ethnicity, race, marital status, education, annual income, employment, insurance, homeownership, household size, number of children, rurality, vehicle ownership.

2.5 Discussion

This study sought to classify U.S. individuals interested in food as medicine programs using socio-ecological indicators of dietary behavior and assess the association of profile membership with likelihood to participate. Results of the latent profile analysis demonstrated that four socio-ecologically different groups were interested in food as medicine programs – the Socially-Limited Capable, High Propensity Capable, Disengage Capable, Low Propensity Vulnerable. Furthermore, the results indicated differences in the proportion of members with a higher likelihood of participation in food as medicine programs exists between groups.

The SLC group was the largest of the four groups. Members of this group had high individual- and physical environment-level indicators for healthy dietary behaviors but low social environment-level indicators. More than 75% of members of the group indicated a higher likelihood of participation in food as medicine programs. The HPC group was characterized by high individual- and social environment-level indicators, and moderate physical environment-level indicators. This group had the highest proportion of members, nearly 93%, indicate a higher likelihood of participation compared to the three other groups. The final two groups, DC and LPV,
had the fewest number of members. The *DC* group was characterized by moderate individual-, social environment-, and physical environment-level indicators for healthy dietary behavior. Only 53% of members in this group indicated a higher likelihood of participation in food as medicine programs. Lastly, the *LPV* group was characterized by low individual- and social environment-level indicators, and moderate physical environment-level indicators. This group had the lowest proportion of individuals (45%) with a higher likelihood of participation.

The results of the adjusted multinomial logistic regression analysis provided further insight into the sociodemographic makeup of the four identified groups. In this study, age, race, ethnicity, relationship status, employment status, annual household income, food insecurity status, rurality, homeownership, personal vehicle ownership, and number of diet-related chronic conditions were all significant differentiators of profile membership. Previous literature has indicated age, race, ethnicity, and income are all correlated with diet quality and produce consumption.\(^6,22,73–76,80–82\) Furthermore, age, sex, race, relationship status, income, employment status, and transportation have been associated food as medicine program utilization.\(^155,199–201\) Thus, it is not surprising these factors were also associated with profile membership.

Examination of the *SLC* and *HPC* groups provides deeper insight into the factors influencing likelihood to participate in food as medicine programs. These groups had high scores for individual-level indicators compared to the *DC* group and *LPV* group, which had significantly lower proportions of members indicate a higher likelihood of participation. This suggests individual-level socio-ecological factors are important predictors for likelihood of participation. Previous literature has shown high self-efficacy, positive attitude, and confidence in personal cooking skills are all essential to healthy food consumption.\(^72,84–88\) High scores on these factors suggest the *SLC* group and *HPC* group are better suited to consume a healthy diet, thus may
recognize the added benefit and importance of participating in a food as medicine program. Additionally, members of these two groups were more likely to be part of a married or unmarried couple, rather than single or never married, compared to the DC group and LPV group. Previous literature has suggested married and unmarried couples are more likely to follow a healthier diet with greater consumption of produce and organic foods, and limited consumption of processed and inorganic foods.\textsuperscript{202–204} This further suggests members of the SLC group and HPC group have better inclination for healthy dietary behaviors and deeper appreciation for benefits of food as medicine programs leading to increased likelihood of participation.

Social environment-level factors also appeared to play a role in the likelihood of participation, but the effects may impact groups differently. The LPV group had the lowest scores for these indicators and fewest proportion of members with a higher likelihood of participation compared to the other groups. This group also had the lowest scores for individual-level indicators. These results suggest a meaningful relationship exists between the two socio-ecological levels, such that individuals with low individual-level factors have trouble overcoming low social environment-level factors and vice versa. Both synergistic and compensatory relationships have been found in previous literature examining the impacts of self-efficacy and social support on healthy behaviors.\textsuperscript{86,205–207} It appears this relationship may be present in the current study as well and influence likelihood to participate in food as medicine programs among the different groups.

Further comparison of social environment-level factors between the groups with large proportions of members indicating higher likelihood of participation, the SLC and HPC groups, revealed social support was an important differentiator. High levels of family and peer support have been found to significantly influence success in diet-related interventions, adherence to dietary recommendations, and health outcomes in previous literature.\textsuperscript{91–95} The HPC group
indicated a higher presence social support, which may have contributed to a greater proportion of members indicating a higher likelihood of participation compared to the SLC group. However, a majority of members in the SLC groups also indicated a higher likelihood of participation despite having low social support. This may be related to members seeking social support for dietary behaviors and the potential for food as medicine program to fulfill this unmet need. Members in the SLC group had greater likelihood of being older, unemployed, and living in rural settings compared to the HPC group. Previous literature has suggested participation in food as medicine programs leads to social interaction between participants providing them with a sense of social belonging and more opportunity for peer support.

Physical environment-level indicators exhibited the least variation, which implies a lower impact on likelihood to participate compared to the other socio-ecological factors examined in the study. The SLC group had the highest score home food environment, which may be influenced by the socio-economic status and low food insecurity of members compared to the other groups. Community availability and accessibility scores were relatively higher for the SLC group and HPC group compared with the other groups. This may be related more members owning a personal vehicle or living in less rural locations. However, vehicle ownership was the only statistically significant differentiator in one of the group comparisons, (HPC vs. DC), suggesting existence of additional factors that were not measured in the current study. Lastly, the HPC group had the highest score for perceived affordability. This may be a result of having the highest rates of employment (87%) and proportion of household with an annual income of $75,000 or more (46.5%) compared to the other groups. Interestingly, the HPC group also had the highest rate of food insecurity. This may explain the low home environment food score and suggests they experience additional stressors that could be improved with participation in food as medicine
This study adds to the literature by identifying and classifying groups of individuals likely to participate in food as medicine programs. However, limitations exist that should be considered when considering the study outcomes. First, the study focused on the general population of U.S. adults interested in food as medicine programs. This may limit the overall generalizability of the results for the entire U.S. population and specific populations, such as minority and underserved individuals, that have been previously targeted in food as medicine program research. However, the use of quota-based sampling ensured the sample was representative of the general population based on age, gender, race, and ethnicity. Additionally, nearly half of respondents were determined to be food insecure, which is frequently used to determine eligibility in previously studied programs. Second, the study employed self-reported survey measures to assess socio-ecological factors and other study variables, which may have introduced several biases into the study, including recall and social-desirability. However, most of the measures used were previously validated. Lastly, the study utilized a cross-sectional design, which precluded any inferences of causality between the associations of group membership, sociodemographic covariates, and likelihood to participate in food as medicine programs. Future research should examine changes in group membership and socio-ecological factors over time as individual perceptions and characteristics may change throughout different stages of life. Furthermore, examination of changes in socio-ecological factors before and after participation in food as medicine programs could provide valuable insight into the impact of these programs beyond diet- and health-related outcomes.

2.6 Conclusions

Initial research on food as medicine programs have shown encouraging evidence for the
potential to reduce food insecurity, improve diet quality, and impact health-related outcomes. However, more robust evidence is needed to advance the strategic development of these programs. The results of this study provide a better understanding of the heterogeneity among individuals interested in food as medicine programs and present differences in socio-ecological factors that may affect likelihood to participate between groups. The utilization of socio-ecological factors to systematically identify groups should allow programs to be tailored and implemented that wholistically meet the needs of these patient populations. This should lead to increased feasibility, acceptability, enrollment, retention, rigor, and relevance of future research.
CHAPTER 3: INDIVIDUAL PREFERENCES FOR FOOD AS MEDICINE PROGRAM
ATTRIBUTES AMONG DIFFERENT SOCIO-ECOLOGICAL GROUPS: A DISCRETE
CHOICE EXPERIMENT
3.1 Background

Despite the well-established link between diet and chronic disease, many Americans fail to achieve healthy dietary patterns.\textsuperscript{11,14} Consumption of more produce has become a point of emphasis in national guidelines, as only 12% and 9% of adults meet the recommended daily intake of fruits and vegetables.\textsuperscript{22} Suboptimal fruit and vegetable intake is a major contributor to the risk of diet-related chronic disease and mortality.\textsuperscript{1,4,16–21} In the past several decades, stakeholders (i.e., health care providers, public health advocates, researchers) have attempted to identify and develop new strategies to address the growing impact of diet-related chronic disease.

Among stakeholders, there is a growing interest in incorporating food as medicine programs into healthcare systems to provide healthy foods as a treatment for vulnerable patients.\textsuperscript{143} A scoping review identified six models being examined in the literature to improve access to fresh produce.\textsuperscript{144} These models include cash-back rebate programs, voucher programs, garden-based programs, subsidized food packages, prepared-meal delivery services, and clinical–food bank collaborations.\textsuperscript{144} Among these models, voucher programs, subsidized food packages, and prepared-meal delivery services have been implemented most frequently.\textsuperscript{144,145} Voucher programs provide a specified amount in incentives, funds, or redeemable coupons to purchase produce at designated locations (i.e., grocery stores, farmers markets).\textsuperscript{144} Subsidized food package programs provide patients with a prepackaged box of fresh produce that is completely or partially paid for by healthcare organizations.\textsuperscript{144} Prepared-meal delivery services are medically tailored, ready-to-eat meals delivered to patients and designed by a Registered Dietitian Nutritionist to meet specific dietary needs.\textsuperscript{145}

Food as medicine programs can improve overall population health if sustainable, replicable, and scalable approaches are developed for deployment across the entire healthcare
Early literature exploring the impact of these programs has shown improved health outcomes and reduced healthcare usage and costs. Overall, evidence indicates that food as medicine programs can impact dietary outcomes leading to increased produce consumption and reduced food insecurity. However, literature regarding health-related and cardiometabolic outcomes has reported mixed effectiveness. These inconsistent findings may be due in part to lack of randomized studies and substantial heterogeneity in research designs, amount of food provided, short duration of programs, and outcomes measured. Nevertheless, these diet and health-related outcomes together provide encouraging evidence that food as medicine programs may impact diet quality and could improve health outcomes over longer periods of time.

Although preliminary research is promising, more robust evidence is needed to identify the most effective models, services, and delivery methods for specific patients and patient populations. As future research begins to address these gaps, incorporating patient input across the entire research process will be an essential component to develop successful programs. To date, researchers and health care professionals have developed food as medicine programs without input from patients on design and implementation. According to the Patient Centered Outcomes Research Institute (PCORI), research driven by patient interests and needs improves uptake and use to address individual health needs. The engagement of patients and public members as consultants or collaborators provides valuable contributions in defining research questions, determining study design, selecting outcomes, and tailoring programs. Furthermore, patient engagement has been shown to increase enrollment, retention, feasibility, acceptability, rigor, and relevance of the research to better align with patients and clinicians’ real-world needs.

Prior literature examining food as medicine programs has not explored patient perspectives.
regarding the design, structure, or attributes of programs before implementation. By examining these perspectives, future research can develop programs designed to meet patients’ needs, which should ultimately increase engagement leading to improved diet and health-related outcomes. As such, this study explored preferences for attributes of food as medicine programs among individuals with diet-related conditions likely to participate. Furthermore, this study sought to examine differences in attribute preferences between latent subgroups of patients identified in the prior study. A stated preference method was used to evaluate the relative importance of different attributes for food as medicine programs. Identifying patient preferences should inform the development of programs for specific target populations, which is an important step in implementing scalable and sustainable food as medicine programs.

3.2 Study objectives

- To examine preferences of food as medicine program attributes among individuals likely to participate.
- To examine differences in the preferences of food as medicine program attributes among identified latent profiles of individuals likely to participate.

3.3 Methods

Study design

A prospective cross-sectional study design was conducted to collect data from a nationally representative sample of U.S. adults. Data were collected via an online survey fielded through Qualtrics survey software (Qualtrics Inc., Provo, UT). The survey used a discrete choice experiment designed to elicit respondents’ preferences regarding attributes of food as medicine programs. Exemption from the University of Mississippi Institutional Review Board (IRB) was given before data collection (protocol #23x-103).
Study sample

Participants were recruited from research panels provided by Qualtrics (Qualtrics Inc., Provo, UT). Quota-based convenience sampling was used to ensure a nationally representative sample based on age, gender, race, and ethnicity. Panel members were eligible to participate in the study based on the following inclusion criteria: aged 18 years or older, English-speaking, diagnosed with at least one diet-related chronic condition, and indicated they were likely to participate in food as medicine programs. Screening questions were used to determine eligibility based on diet-related chronic conditions and the likelihood of participation. Dichotomous response questions (e.g., yes/no) were used to determine the presence of diet-related conditions, and a single rating response format question was used to assess the likelihood of participation. Respondents with no chronic conditions and indication they were unlikely to participate in food as medicine programs were excluded. A target sample of 600 respondents were recruited to participate in the study. Sample size determination was based on previous literature and commonly used approaches to estimate minimum size requirements.  

Data collection

A self-administered online survey was used to collect data for the study. The survey collected data on socio-ecological predictors of dietary behaviors and food consumption, likelihood of participation in food as medicine programs, food security, diet-related conditions, sociodemographic characteristics, and attribute preferences via discrete choice experiments. All survey items were taken or adapted from previous literature, with additional items included as necessary to meet the study objectives. The discrete choice experiment was developed from previous literature regarding food as medicine programs and expert opinion. Prior to data collection, the survey and discrete choice experiment were piloted with 59 graduate students to
assess interpretability, clarity, and cognitive burden. An additional question about dietary restrictions was included based on feedback from pilot participants; no changes were made to the discrete choice experiment. A final version of the survey is provided in the Appendix 1 of the dissertation.

Discrete choice experiment

A choice-based conjoint (CBC) analysis was conducted to elicit respondents’ preferences for food as medicine programs. The CBC analysis requires respondents to choose their most preferred product concept from a set of alternative concepts rather than rating or ranking like other conjoint analysis methods. This approach is favored for pricing research because it closely simulates the natural buying process of choosing a preferred product from alternatives in the marketplace.\textsuperscript{210} Furthermore, CBC allows an opt-out option to be included for respondents to contribute information about decreases in demand if all products became unattractive.\textsuperscript{210}

Experimental design

The final CBC experimental design was determined using Sawtooth Software’s choice-based conjoint analysis module. The final design was identified to ensure optimal design efficiency based on relative D-efficiencies and minimize the respondent burden. A total of 24 designs were examined, which varied in the number of unique survey versions (10, 25, 50, 75, and 300), choice task sets (8 to 15), and opt out rate of respondents (15%, 20%, and 25%). The final design included seven attributes with 20 total levels ($3^3 \times 5^1 \times 3^2$), four concepts per task, 13 choice sets per respondent, and 25 unique survey versions. The design had a relative D-efficiency of 0.879 compared to the default recommended by Sawtooth Software (300 unique versions, 15 choice sets). The balanced overlap method was used to maintain high efficiency and near-orthogonality with respect to main effects while permitting some level overlap within the same task.\textsuperscript{210} An opt
out or “none” option was included in the choice sets to better reflect the buying process. The statement, “I wouldn’t choose to participate in any of these programs.” represented the opt-out option. An example choice task question is provided in Figure 3.1.

**Attributes and attribute levels**

Attributes were identified from previous literature and expert opinions of individuals currently implementing a food as medicine program. Attributes were chosen to elicit preferences regarding two elements of program design that support effective implementation: identification of core components and adaptability to meet the local needs and preferences of different communities. The final attributes and attribute levels, presented in Table 3.1, encompass program structure, payment, and inclusion of additional services.

The first attribute, program type, is aimed to elicit preferences for the model structure of commonly implemented programs. A recent systematic scoping review identified six models currently used within a healthcare setting to improve patient access to fresh produce. Of the six models, voucher programs, subsidized food packages, and prepared-meal delivery services have been the most studied in the literature. Thus, a version of each model was included as a level in the program type attribute.

The second attribute relates to eligibility and enrollment requirements for program participation. Various criteria and procedures have been used to determine eligibility for programs, but most involve some type of referral from health care professionals or insurance plans. Many programs are implemented to target populations with specific chronic diseases or those with low food security. Thus, three levels (chronic condition screening, food security screening, and no screening requirements) were included for the eligibility and enrollment attribute.
Figure 3.1 An example choice task question present to respondents in the choice-based conjoint analysis
The final attribute related to program structure was the amount of produce provided. The quantification of produce provided in previous programs is difficult to contextualize as many provided monetary incentives ranging from $7 to $58 per week rather than direct measurements of food.\textsuperscript{144,145} Programs reporting direct measurements of food have used pounds, number of meals supplemented, and day supply to quantify the amount provided.\textsuperscript{144,145} For this study, the number of meals supplemented per day was chosen to operationalize the amount of produce provided because it is easily interpretable and limited the cognitive burden for respondents. Three levels (1, 2, and 3 meals per day) were included for the attribute.

### Table 3.1 Initial List of Attributes and Level for Discrete Choice Experiment

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Model</td>
<td>Voucher program</td>
</tr>
<tr>
<td></td>
<td>Subsidized food boxes</td>
</tr>
<tr>
<td></td>
<td>Medically tailored meals</td>
</tr>
<tr>
<td>Eligibility and Enrollment</td>
<td>Chronic condition screening</td>
</tr>
<tr>
<td>requirements</td>
<td>Food security screening</td>
</tr>
<tr>
<td></td>
<td>No screening</td>
</tr>
<tr>
<td>Number of meals supplemented</td>
<td>1 meal per day</td>
</tr>
<tr>
<td></td>
<td>2 meals per day</td>
</tr>
<tr>
<td></td>
<td>3 meals per day</td>
</tr>
<tr>
<td>Cost per month</td>
<td>$0 (No cost)</td>
</tr>
<tr>
<td></td>
<td>$30</td>
</tr>
<tr>
<td></td>
<td>$60</td>
</tr>
<tr>
<td></td>
<td>$90</td>
</tr>
<tr>
<td></td>
<td>$120</td>
</tr>
<tr>
<td>Nutrition counseling</td>
<td>Included</td>
</tr>
<tr>
<td></td>
<td>Not included</td>
</tr>
<tr>
<td>Informational material</td>
<td>Included</td>
</tr>
<tr>
<td></td>
<td>Not included</td>
</tr>
<tr>
<td>Cooking demonstrations</td>
<td>Included</td>
</tr>
<tr>
<td></td>
<td>Not included</td>
</tr>
</tbody>
</table>
The cost per month attribute was designed to determine respondent preferences for paying to participate in a food as medicine program. Previously studied programs have lacked sustainable funding mechanisms, which are imperative to the durability and longevity needed to achieve meaningful improvement in health-related outcomes.\textsuperscript{212} Only several studies have implemented payments from participants, so cost per month levels were determined using the monetary incentive ranges identified in previous literature and expert opinion.\textsuperscript{144,145} Five levels ($0, $30, $60, $90, $120) were included to assess respondents’ willingness to pay for program participation.

The final attributes are meant to capture preferences for additional services commonly included with food as medicine programs. Many programs identified in the literature provide resources or services that augment food-based incentives to enhance program effectiveness and further support healthy lifestyle modifications.\textsuperscript{144,145} Three services were incorporated as separate attributes in the study: nutrition counseling, cooking demonstrations, and informational handouts.\textsuperscript{144,145} These were included as individual, stand-alone attributes (two levels: included, not included) to allow variation in the number and combination of services provided as seen in previous literature.\textsuperscript{144,145}

\textit{Study Variables}

\textit{Socio-ecological factors}

An adapted Socio-Ecological (SE) model for participation in food as medicine programs was used to identify latent profiles in the prior study. The model included the following indicators identified from previous literature: self-efficacy, attitude, and cooking confidence, family and social support, cultural influence, home food environment, community availability and accessibility, and affordability of healthy food.\textsuperscript{61,72} Previously developed instruments were included in the survey to gather data for the latent profile indicators using multipoint response
format scales. Results of the latent profile analysis identified four groups of individuals likely to participate in food as medicine programs, the *Socially-Limited Capable (SLC)* group, *High Propensity Capable (HPC)* group, *Disengaged Capable (DC)* group, and *Low Propensity Vulnerable (LPV)* group. These groups were included in the study to examine associations between group membership and attribute preferences.

**Food security**

The Six-Item Short Form Food Security questionnaire was used to assess household food security among respondents. Respondents were asked about their food situation in the last 30 days, which included affording to eat a balanced meal, purchasing more of foods that did not last, cutting or skipping meals, eating less than they should, and being hungry but not eating. Raw scale scores were calculated (range 0 to 6) and dichotomized based on food security status (food secure = 0; food insecure = 1) according to recommendations. Food security status was used as a covariate in data analysis.

**Chronic health conditions**

Information about diet-related chronic conditions was collected as part of the screening process. Dichotomous response questions (e.g., yes/no) were taken from the 2020 Behavioral Risk Factor Surveillance System (BRFSS) questionnaire, which collects data from U.S. residents regarding their health-related behaviors, conditions, and utilization of health services. The following physician diagnosed conditions were included: hypertension, hypercholesteremia, coronary artery disease, stroke, obesity, pre-diabetes, and type 2 diabetes. Individuals with at least one diagnosis were included in the study, and the number of chronic conditions was used as a covariate in data analyses.

**Sociodemographic characteristics**
Adapted questions from the 2020 BRFFS demographic core section were used to collect sociodemographic characteristics. The following sociodemographic characteristics were collected: 1. Age in years; 2. Gender; 3. Hispanic, Latino/a, or Spanish origin; 4. Race; 5. Marital or relationship status; 6. Level of education; 7. Annual household income; 8. Employment status; 9. Healthcare insurance status; 10. Housing arrangement; 11. Household size; 12. Number of children in household; 13. Area of residence; 14. Access to transportation; and 15. Dietary regimen or restrictions. Sociodemographic characteristics were included as covariates in the data analyses.

Data Analysis

Descriptive statistics were performed to summarize sociodemographic characteristics, diet-related conditions, and food security in the study sample. Continuous variables were assessed using means and standard deviations; categorical variables were assessed using frequencies. All descriptive statistics were conducted using IBM Statistical Package for the Social Sciences (SPSS) Statistics version 27.

Hierarchical Bayesian (HB) estimation was used to determine the part-worth utility values of each attribute level at the individual respondent-level. This process assumes that respondents answered the choice tasks according to a multinomial logit model, which considers the probability of the alternative chosen related to the proportion of the total utility for that concept relative to the total utility for all concepts. The zero-centered utility values were used to represent the relative desirability of the levels within each attribute, with positive values indicating preference and larger values indicating greater desirability or worth. Additionally, individual-level attribute importance scores were calculated to examine the magnitude of influence each attribute category had on respondents’ preference regarding concept decision-making. Higher attribute importance scores indicate that levels within that attribute influenced the respondent’s choice for program
engagement. The HB estimation was performed in Sawtooth Lighthouse Studio.214

After the HB estimation, the individual-level utility values and importance scores were used to examine associations between program preferences and group membership in the previously identified latent profiles. The utility values and importance scores were treated as continuous dependent variables for analyses. The manual Bolck, Croon, and Hagenaars (BCH) method for determining distal outcomes was employed to adjust for sociodemographic covariates.197 First, an optimal model was identified in the previous study using only the latent profile indicator variables to generate BCH weights.197 This optimal model was used to create a general auxiliary model conditional on the latent profile variable using BCH weights to prevent a class shift from occurring.197 A multivariable linear regression analysis was conducted during this last step to examine the association of program preferences and group membership while adjusting for covariates. All categorical covariates were centered before this step. All BCH and regression analyses were performed in Mplus Software version 8.8.198 A two-sided p-value of 0.05 was used to determine statistical significance and 95% confidence intervals were reported.

3.4 Results

Sample characteristics

A total of 3,587 individuals interacted with the survey invitation distributed by Qualtrics, which resulted in 2,680 respondents beginning the survey. Of these entrants, 599 completed responses were included for data analyses in the study (22.4% response rate). The sample demographic and household characteristics are presented in Table 3.2. The final respondent sample was representative of the U.S. population based on gender (51.3% female), race (76.0% White; 13.0% Black; 6.2% Asian or Pacific Islander), ethnicity (18.0% Hispanic), and had a mean age of 48.5 years (SD± 17.8). Most respondents were college graduates (51.1%), married (50.8%),
Table 3.2 Demographic and household characteristics of the study sample

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Overall (N = 599)</th>
<th>Socially-Limited Capable (n = 234)</th>
<th>High Propensity Capable (n = 129)</th>
<th>Disengaged Capable (n = 118)</th>
<th>Low Propensity Vulnerable (n = 118)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (SD)</td>
<td>48.5 (17.8)</td>
<td>55.4 (17.6)</td>
<td>38.2 (12.6)</td>
<td>42.5 (17.3)</td>
<td>51.9 (16.5)</td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>307 (51.3)</td>
<td>119 (50.9)</td>
<td>67 (51.9)</td>
<td>63 (53.4)</td>
<td>58 (49.2)</td>
</tr>
<tr>
<td>Hispanic Latino/a, or Spanish Ethnicity, n (%)</td>
<td>108 (18.0)</td>
<td>31 (13.2)</td>
<td>27 (20.9)</td>
<td>38 (32.2)</td>
<td>12 (10.2)</td>
</tr>
<tr>
<td>Race, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>455 (76.0)</td>
<td>174 (74.4)</td>
<td>96 (74.4)</td>
<td>91 (77.1)</td>
<td>94 (79.7)</td>
</tr>
<tr>
<td>Black</td>
<td>78 (13.0)</td>
<td>31 (13.2)</td>
<td>23 (17.8)</td>
<td>13 (11.0)</td>
<td>11 (9.3)</td>
</tr>
<tr>
<td>American Indian</td>
<td>9 (1.5)</td>
<td>4 (1.7)</td>
<td>3 (2.3)</td>
<td>2 (1.7)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Asian or Pacific Islander</td>
<td>37 (6.2)</td>
<td>18 (7.7)</td>
<td>6 (4.7)</td>
<td>6 (5.1)</td>
<td>7 (5.9)</td>
</tr>
<tr>
<td>Other</td>
<td>20 (3.3)</td>
<td>7 (3.0)</td>
<td>1 (0.8)</td>
<td>6 (5.1)</td>
<td>6 (5.1)</td>
</tr>
<tr>
<td>Highest level of education, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school or less (1st-11th)</td>
<td>5 (0.9)</td>
<td>1 (0.4)</td>
<td>1 (0.8)</td>
<td>1 (0.8)</td>
<td>2 (1.7)</td>
</tr>
<tr>
<td>High school graduate (12th or GED)</td>
<td>101 (16.9)</td>
<td>40 (17.1)</td>
<td>21 (16.3)</td>
<td>16 (13.6)</td>
<td>24 (20.3)</td>
</tr>
<tr>
<td>Some college or technical school (1-3 years)</td>
<td>187 (31.2)</td>
<td>77 (32.9)</td>
<td>17 (13.2)</td>
<td>41 (34.7)</td>
<td>52 (44.1)</td>
</tr>
<tr>
<td>College graduate (4 or more years)</td>
<td>202 (33.7)</td>
<td>71 (30.3)</td>
<td>53 (41.1)</td>
<td>47 (39.8)</td>
<td>31 (26.3)</td>
</tr>
<tr>
<td>Advanced degree graduate (e.g., M.S., Ph.D.)</td>
<td>104 (17.4)</td>
<td>45 (19.2)</td>
<td>37 (28.7)</td>
<td>13 (11.0)</td>
<td>9 (7.6)</td>
</tr>
<tr>
<td>Relationship status, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>304 (50.8)</td>
<td>126 (53.8)</td>
<td>86 (66.7)</td>
<td>47 (39.8)</td>
<td>45 (38.1)</td>
</tr>
<tr>
<td>Widowed</td>
<td>26 (4.3)</td>
<td>15 (6.4)</td>
<td>1 (0.8)</td>
<td>2 (1.7)</td>
<td>8 (6.8)</td>
</tr>
<tr>
<td>Divorced or separated</td>
<td>59 (9.8)</td>
<td>26 (11.1)</td>
<td>6 (4.7)</td>
<td>14 (11.8)</td>
<td>13 (11.0)</td>
</tr>
<tr>
<td>Single/never married</td>
<td>168 (28.0)</td>
<td>51 (21.8)</td>
<td>27 (20.9)</td>
<td>43 (36.4)</td>
<td>47 (39.8)</td>
</tr>
<tr>
<td>Unmarried couple</td>
<td>42 (7.0)</td>
<td>16 (6.8)</td>
<td>9 (7.0)</td>
<td>12 (10.2)</td>
<td>5 (4.2)</td>
</tr>
</tbody>
</table>
Table 3.2 (cont.) Demographic and household characteristics of the study sample

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Overall N = 599</th>
<th>Socially-Limited Capable n = 234</th>
<th>High Propensity Capable n = 129</th>
<th>Disengaged Capable n = 118</th>
<th>Low Propensity Vulnerable n = 118</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment status, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed full-time or part-time</td>
<td>337 (56.3)</td>
<td>105 (44.9)</td>
<td>112 (86.8)</td>
<td>72 (61.0)</td>
<td>48 (40.7)</td>
</tr>
<tr>
<td>Unemployed</td>
<td>34 (5.7)</td>
<td>11 (4.7)</td>
<td>3 (2.3)</td>
<td>11 (9.3)</td>
<td>9 (7.6)</td>
</tr>
<tr>
<td>Stay at home parent or homemaker</td>
<td>33 (5.5)</td>
<td>18 (7.7)</td>
<td>3 (2.3)</td>
<td>5 (4.2)</td>
<td>7 (5.9)</td>
</tr>
<tr>
<td>Retired</td>
<td>143 (23.9)</td>
<td>80 (34.2)</td>
<td>9 (7.0)</td>
<td>16 (13.6)</td>
<td>38 (32.2)</td>
</tr>
<tr>
<td>Student</td>
<td>17 (2.8)</td>
<td>9 (3.8)</td>
<td>0 (0.0)</td>
<td>7 (5.9)</td>
<td>1 (0.8)</td>
</tr>
<tr>
<td>Disabled or unable to work</td>
<td>35 (5.8)</td>
<td>11 (4.7)</td>
<td>2 (1.6)</td>
<td>7 (5.9)</td>
<td>15 (12.7)</td>
</tr>
<tr>
<td>Health insurance status, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private insurance through employer or marketplace</td>
<td>270 (45.1)</td>
<td>91 (38.9)</td>
<td>79 (61.2)</td>
<td>56 (47.5)</td>
<td>44 (37.3)</td>
</tr>
<tr>
<td>Medicare</td>
<td>184 (30.7)</td>
<td>94 (40.2)</td>
<td>28 (21.7)</td>
<td>25 (21.2)</td>
<td>37 (31.4)</td>
</tr>
<tr>
<td>Medicaid</td>
<td>79 (13.2)</td>
<td>24 (10.3)</td>
<td>14 (10.9)</td>
<td>23 (19.5)</td>
<td>18 (15.3)</td>
</tr>
<tr>
<td>Other (Dual enrollment, TRICARE, Indian Health Services)</td>
<td>24 (4.0)</td>
<td>18 (7.7)</td>
<td>5 (3.9)</td>
<td>11 (9.3)</td>
<td>11 (9.3)</td>
</tr>
<tr>
<td>No health insurance</td>
<td>21 (3.5)</td>
<td>7 (3.0)</td>
<td>3 (2.3)</td>
<td>3 (2.5)</td>
<td>8 (6.8)</td>
</tr>
<tr>
<td>Mean number of diet-related chronic conditions (SD)</td>
<td>2.6 (1.4)</td>
<td>2.4 (1.3)</td>
<td>2.9 (1.7)</td>
<td>2.8 (1.4)</td>
<td>2.4 (1.2)</td>
</tr>
<tr>
<td>Mean household size (SD)</td>
<td>2.7 (1.4)</td>
<td>2.4 (1.4)</td>
<td>3.2 (1.2)</td>
<td>3.0 (1.4)</td>
<td>2.4 (1.3)</td>
</tr>
<tr>
<td>Mean number of children per household (SD)</td>
<td>0.6 (0.9)</td>
<td>0.4 (0.9)</td>
<td>1.0 (0.9)</td>
<td>0.8 (1.0)</td>
<td>0.3 (0.8)</td>
</tr>
<tr>
<td>Characteristic</td>
<td>Overall N = 599</td>
<td>Socially Limited Capable n = 234</td>
<td>High Propensity Capable n = 129</td>
<td>Disengaged Capable n = 118</td>
<td>Low Propensity Vulnerable n = 118</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-----------------</td>
<td>----------------------------------</td>
<td>---------------------------------</td>
<td>-----------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Annual household income, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; $10,000</td>
<td>22 (3.7)</td>
<td>5 (2.1)</td>
<td>3 (2.3)</td>
<td>6 (5.1)</td>
<td>8 (6.8)</td>
</tr>
<tr>
<td>$10,000 – $14,999</td>
<td>20 (3.3)</td>
<td>7 (3.0)</td>
<td>2 (1.6)</td>
<td>5 (4.2)</td>
<td>6 (5.1)</td>
</tr>
<tr>
<td>$15,000 – $19,999</td>
<td>24 (4.0)</td>
<td>7 (3.0)</td>
<td>4 (3.1)</td>
<td>6 (5.1)</td>
<td>7 (5.9)</td>
</tr>
<tr>
<td>$20,000 – $24,999</td>
<td>33 (5.5)</td>
<td>12 (5.1)</td>
<td>4 (3.1)</td>
<td>8 (6.8)</td>
<td>9 (7.6)</td>
</tr>
<tr>
<td>$25,000 – $34,999</td>
<td>58 (9.7)</td>
<td>31 (13.2)</td>
<td>5 (3.9)</td>
<td>10 (8.5)</td>
<td>12 (10.2)</td>
</tr>
<tr>
<td>$35,000 – $49,999</td>
<td>95 (15.9)</td>
<td>30 (12.8)</td>
<td>15 (11.6)</td>
<td>26 (22.0)</td>
<td>24 (20.3)</td>
</tr>
<tr>
<td>$50,000 – $74,999</td>
<td>160 (26.7)</td>
<td>65 (27.8)</td>
<td>36 (27.9)</td>
<td>27 (22.9)</td>
<td>32 (27.1)</td>
</tr>
<tr>
<td>$75,000 – $99,999</td>
<td>75 (12.5)</td>
<td>33 (14.1)</td>
<td>21 (16.3)</td>
<td>12 (10.2)</td>
<td>9 (7.6)</td>
</tr>
<tr>
<td>$100,000 – $149,999</td>
<td>75 (12.5)</td>
<td>28 (12.0)</td>
<td>26 (20.2)</td>
<td>13 (11.0)</td>
<td>8 (6.8)</td>
</tr>
<tr>
<td>≥ $150,000</td>
<td>37 (6.2)</td>
<td>16 (6.8)</td>
<td>13 (10.1)</td>
<td>5 (4.2)</td>
<td>3 (2.5)</td>
</tr>
<tr>
<td>Homeownership, n (%)</td>
<td>380 (63.4)</td>
<td>145 (62.0)</td>
<td>96 (74.4)</td>
<td>70 (59.3)</td>
<td>69 (58.5)</td>
</tr>
<tr>
<td>Residential location, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban or inner-city</td>
<td>199 (33.2)</td>
<td>61 (26.1)</td>
<td>68 (52.7)</td>
<td>41 (34.7)</td>
<td>29 (24.6)</td>
</tr>
<tr>
<td>Suburban</td>
<td>251 (41.9)</td>
<td>107 (45.7)</td>
<td>40 (31.0)</td>
<td>52 (44.1)</td>
<td>52 (44.1)</td>
</tr>
<tr>
<td>Rural/countryside, town or village</td>
<td>37 (6.2)</td>
<td>66 (28.2)</td>
<td>21 (16.3)</td>
<td>25 (21.2)</td>
<td>37 (31.4)</td>
</tr>
<tr>
<td>Personal vehicle ownership, n (%)</td>
<td>505 (84.3)</td>
<td>200 (85.5)</td>
<td>117 (90.7)</td>
<td>90 (76.3)</td>
<td>98 (83.1)</td>
</tr>
<tr>
<td>Food insecure, n (%)</td>
<td>285 (47.6)</td>
<td>67 (28.6)</td>
<td>98 (76.0)</td>
<td>76 (64.4)</td>
<td>44 (37.3)</td>
</tr>
<tr>
<td>Dietary regimen or restrictions, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegan</td>
<td>38 (6.3)</td>
<td>4 (1.7)</td>
<td>27 (20.9)</td>
<td>7 (5.9)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Vegetarian</td>
<td>37 (6.2)</td>
<td>8 (3.4)</td>
<td>17 (13.2)</td>
<td>12 (10.2)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Pescatarian</td>
<td>39 (6.5)</td>
<td>10 (4.3)</td>
<td>22 (17.1)</td>
<td>6 (5.1)</td>
<td>1 (0.8)</td>
</tr>
<tr>
<td>No dietary regimens or restrictions</td>
<td>485 (81.0)</td>
<td>212 (90.6)</td>
<td>63 (48.8)</td>
<td>93 (78.8)</td>
<td>117 (99.2)</td>
</tr>
<tr>
<td>Higher likelihood of participation, n (%)</td>
<td>387 (64.6)</td>
<td>159 (67.9)</td>
<td>119 (92.2)</td>
<td>63 (53.4)</td>
<td>46 (39.0)</td>
</tr>
</tbody>
</table>
employed part- or full-time (56.3%), and had private health insurance (45.1%). The mean number of diet-related chronic conditions was 2.6 (SD± 1.4) and 47.6% of respondents were determined to be food insecure. Among household characteristics, most respondents had an annual household income of $50,000 or greater (57.9%), were homeowners (63.4%), and lived in urban or suburban locations (75.1%). The mean household size was 2.7 (SD± 1.4), with an average of 0.6 (SD± 0.9) children per household. For the CBC analysis, a total of 311 (51.9%) of respondents never selected the opt-out option and 7 (1.2%) always selected the option.

Relative importance scores and part-worth utility values

The overall results of the HB estimation to determine importance scores and utility values are presented in Table 3.3. The results indicated that cost per month was the most important attribute (M = 42.44% [95% CI 40.74–44.14]) when choosing to participate in a food as medicine program, followed by the number of meals supplemented (M = 13.93% [95% CI 13.27–14.60]) and eligibility and enrollment requirements (M = 11.86% [95% CI 11.24–12.48]). Additional services had the least influence on respondents’ preferences, with cooking demonstrations (M = 7.95% [95% CI 7.36–8.54]) and nutrition counseling (M = 6.97% [95% CI 6.50–7.44]) being the most and least important of the three services, respectively.

Examination of mean utility values for attribute levels within program model, eligibility and enrollment requirements, number of meals supplemented, and cost per month provides further insight into respondents’ preferences. In the program model attribute, respondents most preferred medically tailored meal programs (M = 6.60) followed by pre-assembled food box (M = 3.08) and voucher (M = –9.68) programs. For eligibility and enrollment requirements, respondents most preferred chronic condition screening (M = 25.45) followed by no screening requirements (M = –0.59) and food security screening (M = –24.85). Respondents’ preference for number of meals
Table 3.3 Overall Mean Importance Scores and Level Utility Value Estimates

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Levels</th>
<th>Mean Utility</th>
<th>Lower 95% CI</th>
<th>Upper 95% CI</th>
<th>Mean Importance Score (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Model</td>
<td>Voucher</td>
<td>–9.68</td>
<td>–12.86</td>
<td>–6.50</td>
<td>9.12% (8.54 – 9.69)</td>
</tr>
<tr>
<td></td>
<td>Subsidized food box</td>
<td>3.08</td>
<td>0.54</td>
<td>5.63</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Medically tailored meal</td>
<td>6.60</td>
<td>4.13</td>
<td>9.07</td>
<td></td>
</tr>
<tr>
<td>Eligibility and enrollment</td>
<td>Chronic condition screening</td>
<td>25.45</td>
<td>22.03</td>
<td>28.86</td>
<td>11.86% (11.24 – 12.48)</td>
</tr>
<tr>
<td></td>
<td>Food security screening</td>
<td>–24.85</td>
<td>–27.68</td>
<td>–22.02</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No screening</td>
<td>–0.59</td>
<td>–3.21</td>
<td>2.03</td>
<td></td>
</tr>
<tr>
<td>Meals supplemented</td>
<td>1 meal per day</td>
<td>–44.42</td>
<td>–47.48</td>
<td>–41.37</td>
<td>13.93% (13.27 – 14.60)</td>
</tr>
<tr>
<td></td>
<td>2 meals per day</td>
<td>6.77</td>
<td>5.35</td>
<td>8.18</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 meals per day</td>
<td>37.66</td>
<td>34.50</td>
<td>40.81</td>
<td></td>
</tr>
<tr>
<td>Cost of participation per month</td>
<td>$0</td>
<td>137.20</td>
<td>126.80</td>
<td>147.50</td>
<td>42.44% (40.74 – 44.14)</td>
</tr>
<tr>
<td></td>
<td>$30</td>
<td>63.50</td>
<td>59.26</td>
<td>67.73</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$60</td>
<td>–8.58</td>
<td>–12.05</td>
<td>–5.12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$90</td>
<td>–75.50</td>
<td>–80.69</td>
<td>–70.31</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$120</td>
<td>–116.60</td>
<td>–123.00</td>
<td>–110.20</td>
<td></td>
</tr>
<tr>
<td>Nutrition counseling</td>
<td>Included</td>
<td>19.41</td>
<td>17.39</td>
<td>21.44</td>
<td>6.97% (6.50 – 7.44)</td>
</tr>
<tr>
<td></td>
<td>Not included</td>
<td>–19.41</td>
<td>–21.43</td>
<td>–17.39</td>
<td></td>
</tr>
<tr>
<td>Informational material</td>
<td>Included</td>
<td>18.03</td>
<td>15.41</td>
<td>20.65</td>
<td>7.74% (7.15 – 8.32)</td>
</tr>
<tr>
<td></td>
<td>Not included</td>
<td>–18.03</td>
<td>–20.65</td>
<td>–15.41</td>
<td></td>
</tr>
<tr>
<td>Cooking demonstrations</td>
<td>Included</td>
<td>20.92</td>
<td>18.38</td>
<td>23.47</td>
<td>7.95% (7.36 – 8.54)</td>
</tr>
<tr>
<td></td>
<td>Not included</td>
<td>–20.92</td>
<td>–23.47</td>
<td>–18.38</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* N = 599; CI = Confidence Interval; HB Zero-centered utility values were utilized to represent the relative desirability of the levels within each attribute; higher values indicate more desirable characteristics.
supplemented decreased in order from 3 meals per day being the most preferred \( (M = 25.45) \) to 1 meal per day being the least preferred \( (M = -44.42) \). Preferences for cost of participation indicated $0 per month was the most preferred \( (M = 137.20) \), with each subsequent price increase becoming less preferred than the last. Lastly, respondents preferred having nutrition counseling \( (M = 19.41) \), informational material \( (M = 18.03) \), and cooking demonstrations \( (M = 20.92) \) included rather than not included.

**Association between profile membership and program preferences**

Results of the BCH analysis examining the association between group membership and food as medicine program attribute preferences, while adjusting for covariates, are presented in Table 3.4. The omnibus Wald chi-square test was statistically significant for cost per month \( (\chi^2(3) = 30.017, p < 0.001) \), nutrition counseling \( (\chi^2(3) = 15.720, p = 0.001) \), informational material \( (\chi^2(3) = 30.817, p < 0.001) \), and cooking demonstrations \( (\chi^2(3) = 30.004, p < 0.001) \), indicating there were differences in attribute importance scores across the four groups. Further evaluation of individual pairwise comparisons between groups is presented in Table 3.5.

For the number of meals supplemented, the HPC group had significantly lower importance scores compared to the SLC group \( (14.61 \text{ vs. } 17.74, p \leq 0.05) \). Comparisons of cost per month indicated the attribute had significantly lower importance for the HPC group compared with the other three groups, \( (\text{SLC group: 33.10 vs. 43.84, } p \leq 0.001; \text{ DC group: 33.10 vs. 41.70, } p \leq 0.05; \text{ LPV group: 33.10 vs. 50.82, } p \leq 0.001) \). Furthermore, the LPV group placed significantly higher importance on cost per month compared to the SLC group \( (50.82 \text{ vs. } 43.84, p \leq 0.05) \) and the DC group \( (50.82 \text{ vs. } 41.70, p \leq 0.05) \). For nutritional counseling, the HPC group placed significantly higher importance on the attribute than the SLC group \( (7.82 \text{ vs. } 5.23, p \leq 0.05) \); the LPV group had significantly lower importance scores compared to the HPC group \( (4.25 \text{ vs. } 7.82, p \leq 0.001) \) and
### Table 3.4 Adjusted Class-Specific Means of Distal Outcome Attribute Importance Scores

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Socially-Limited Capable</th>
<th>High Propensity Capable</th>
<th>Disengaged Capable</th>
<th>Low Propensity Vulnerable</th>
<th>Wald chi-square</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Model</td>
<td>11.28 (1.11)</td>
<td>10.42 (1.35)</td>
<td>10.76 (1.34)</td>
<td>9.76 (1.15)</td>
<td>2.389</td>
<td>0.496</td>
</tr>
<tr>
<td>Eligibility and enrollment</td>
<td>12.31 (1.14)</td>
<td>13.78 (1.62)</td>
<td>12.62 (1.63)</td>
<td>11.27 (1.33)</td>
<td>4.235</td>
<td>0.237</td>
</tr>
<tr>
<td>Meals supplemented</td>
<td>17.74 (1.22)</td>
<td>14.61 (1.56)</td>
<td>15.49 (1.85)</td>
<td>15.63 (1.37)</td>
<td>6.744</td>
<td>0.081</td>
</tr>
<tr>
<td>Cost per month</td>
<td>43.84 (2.90)</td>
<td>33.10 (3.28)</td>
<td>41.70 (3.93)</td>
<td>50.82 (3.29)</td>
<td>30.017</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Nutrition counseling</td>
<td>5.23 (0.81)</td>
<td>7.82 (0.99)</td>
<td>6.07 (1.06)</td>
<td>4.25 (0.87)</td>
<td>15.720</td>
<td>0.001**</td>
</tr>
<tr>
<td>Informational material</td>
<td>5.37 (0.95)</td>
<td>11.44 (1.34)</td>
<td>6.86 (1.31)</td>
<td>4.90 (0.92)</td>
<td>30.817</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Cooking demonstrations</td>
<td>4.72 (0.83)</td>
<td>10.56 (1.37)</td>
<td>7.51 (1.28)</td>
<td>3.86 (0.85)</td>
<td>30.004</td>
<td>&lt;0.001**</td>
</tr>
</tbody>
</table>

*Note.* N = 575. * Statistically significant at p-value ≤ 0.05; ** Statistically significant at p-value ≤ 0.001; SE = Standard Error; Covariates adjusted for include age, gender, ethnicity, race, marital status, education, annual income, employment, insurance, homeownership, household size, number of children, rurality, vehicle ownership.
### Table 3.5 Adjusted Differences Between Class-Specific Means of Distal Outcome Attribute Importance Scores

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Mean Importance Score (%)</th>
<th>SLC</th>
<th>HPC</th>
<th>DC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eligibility and enrollment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socially-Limited Capable</td>
<td>12.31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Propensity Capable</td>
<td>13.78</td>
<td>1.47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disengaged Capable</td>
<td>12.62</td>
<td>0.31</td>
<td>-1.16</td>
<td></td>
</tr>
<tr>
<td>Low Propensity Vulnerable</td>
<td>11.27</td>
<td>-1.04</td>
<td>-2.51</td>
<td>-1.35</td>
</tr>
<tr>
<td><strong>Meals supplemented</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socially-Limited Capable</td>
<td>17.74</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Propensity Capable</td>
<td>14.61</td>
<td>-3.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disengaged Capable</td>
<td>15.49</td>
<td>-2.25</td>
<td>0.88</td>
<td></td>
</tr>
<tr>
<td>Low Propensity Vulnerable</td>
<td>15.63</td>
<td>-2.11</td>
<td>1.02</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>Cost per month</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socially-Limited Capable</td>
<td>43.84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Propensity Capable</td>
<td>33.10</td>
<td>-10.74</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>Disengaged Capable</td>
<td>41.70</td>
<td>-2.14</td>
<td>8.60</td>
<td>*</td>
</tr>
</tbody>
</table>
| Low Propensity Vulnerable       | 50.82                     | 6.98 | 17.72|**  | 9.12|*
| **Nutrition counseling**        |                           |      |      |     |
| Socially-Limited Capable        | 5.23                      |      |      |     |
| High Propensity Capable         | 7.82                      | 2.59 |*    |     |
| Disengaged Capable              | 6.07                      | 0.84 | -1.75|     |
| Low Propensity Vulnerable       | 4.25                      | -0.98| -3.57|**  | -1.82|*
| **Informational material**      |                           |      |      |     |
| Socially-Limited Capable        | 5.37                      |      |      |     |
| High Propensity Capable         | 11.44                     | 6.07 |**   |     |
| Disengaged Capable              | 6.86                      | 1.49 | -4.58|**  |     |
| Low Propensity Vulnerable       | 4.90                      | -0.47| -6.54|**  | -1.96|
| **Cooking demonstrations**      |                           |      |      |     |
| Socially-Limited Capable        | 4.72                      |      |      |     |
| High Propensity Capable         | 10.56                     | 5.84 |**   |     |
| Disengaged Capable              | 7.51                      | 2.79 | -3.05|*    |
| Low Propensity Vulnerable       | 3.86                      | -0.86| -6.70|**  | -3.65|**

Note. N = 575. SLC is comparison with the Socially-Limited Capable; HPC is comparison with the High Propensity Capable group; DC is comparison with the Disengaged Capable group. * Statistically significant at p-value ≤ 0.05; ** Statistically significant at p-value ≤ 0.001; Covariates adjusted for include age, gender, ethnicity, race, marital status, education, annual income, employment, insurance, homeownership, household size, number of children, rurality, vehicle ownership.
the DC group (4.25 vs. 6.07, \( p \leq 0.05 \)). Comparisons of informational material revealed the HPC group had significantly higher importance scores compared the other three groups, (SLC group: 11.44 vs. 5.37, \( p \leq 0.001 \); DC group: 11.44 vs. 6.86, \( p \leq 0.001 \); LPV group: 11.44 vs. 4.90, \( p \leq 0.001 \)). Lastly, the HPC group placed significantly higher importance on cooking demonstrations compared the other three groups, (SLC group: 10.56 vs. 4.72, \( p \leq 0.001 \); DC group: 10.56 vs. 7.51, \( p \leq 0.05 \); LPV group: 10.56 vs. 3.86, \( p \leq 0.001 \)). Additionally, the DC group had significantly higher importance scores compared with the SLC group (7.51 vs. 4.72, \( p \leq 0.05 \)) and LPV group (7.51 vs. 3.86, \( p \leq 0.001 \)).

Results of the BCH analysis examining the association between group membership and attribute level preferences for program model, eligibility and enrollment requirements, number of meals supplemented, and cost per month, while adjusting for covariates, are presented in Table 3.6. In the program model attribute, the DC preferred a medically tailored meal program, while the three other groups preferred the pre-assembled food box program model. For eligibility and enrollment, the LPV preferred no screening requirements, while the three other groups preferred screening by chronic conditions for participation in food as medicine programs. The final two attribute level comparisons revealed that all four groups preferred programs that supplemented 3 meals per day and cost $0 per month for participation.
Table 3.6 Adjusted Class-Specific Means of Distal Outcome Attribute Level Utility Value Estimates

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Levels</th>
<th>Socially-Limited Capable</th>
<th>High Propensity Capable</th>
<th>Disengaged Capable</th>
<th>Low Propensity Vulnerable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Subsidized food box</td>
<td>12.07 (4.53)</td>
<td>8.14 (6.15)</td>
<td>8.80 (6.88)</td>
<td>9.53 (5.46)</td>
</tr>
<tr>
<td></td>
<td>Medically tailored meal</td>
<td>9.89 (4.09)</td>
<td>7.76 (5.36)</td>
<td>11.28 (5.68)</td>
<td>0.81 (4.66)</td>
</tr>
<tr>
<td>Eligibility and enrollment</td>
<td>Chronic condition screening</td>
<td>24.31 (6.04)</td>
<td>24.49 (8.37)</td>
<td>15.26 (9.21)</td>
<td>11.74 (7.54)</td>
</tr>
<tr>
<td></td>
<td>Food security screening</td>
<td>–28.57 (4.50)</td>
<td>–14.15 (7.06)</td>
<td>–18.31 (7.13)</td>
<td>–26.48 (5.32)</td>
</tr>
<tr>
<td></td>
<td>No screening</td>
<td>5.29 (5.28)</td>
<td>–9.09 (7.56)</td>
<td>4.22 (7.81)</td>
<td>15.96 (6.30)</td>
</tr>
<tr>
<td>Meals supplemented</td>
<td>1 meal per day</td>
<td>–65.52 (5.54)</td>
<td>–36.39 (7.96)</td>
<td>–43.91 (8.47)</td>
<td>–58.83 (6.20)</td>
</tr>
<tr>
<td></td>
<td>2 meals per day</td>
<td>9.23 (2.63)</td>
<td>1.65 (3.80)</td>
<td>–1.67 (3.75)</td>
<td>10.32 (2.81)</td>
</tr>
<tr>
<td></td>
<td>3 meals per day</td>
<td>55.10 (5.43)</td>
<td>32.00 (8.11)</td>
<td>43.72 (8.93)</td>
<td>47.12 (5.96)</td>
</tr>
<tr>
<td>Cost per month</td>
<td>$0</td>
<td>150.61 (18.10)</td>
<td>89.72 (21.52)</td>
<td>137.66 (25.34)</td>
<td>193.21 (19.29)</td>
</tr>
<tr>
<td></td>
<td>$30</td>
<td>75.90 (6.95)</td>
<td>46.59 (9.74)</td>
<td>65.83 (10.26)</td>
<td>79.13 (6.60)</td>
</tr>
<tr>
<td></td>
<td>$60</td>
<td>–4.22 (6.31)</td>
<td>3.02 (7.79)</td>
<td>–8.92 (8.66)</td>
<td>–17.00 (6.46)</td>
</tr>
<tr>
<td></td>
<td>$90</td>
<td>–80.23 (8.95)</td>
<td>–45.43 (11.20)</td>
<td>–77.50 (12.33)</td>
<td>–97.66 (9.40)</td>
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<td>$120</td>
<td>–144.25 (9.71)</td>
<td>–92.04 (13.30)</td>
<td>–117.72 (14.23)</td>
<td>–160.09 (10.65)</td>
</tr>
</tbody>
</table>

Note. N = 575. SE = Standard Error; HB Zero-centered utility values were utilized to represent the relative desirability of the levels within each attribute; higher values indicate more desirable characteristics. Covariates adjusted for include age, gender, ethnicity, race, marital status, education, annual income, employment, insurance, homeownership, household size, number of children, rurality, vehicle ownership.
3.5 Discussion

This study sought to identify preferences for food as medicine program attributes among individuals likely to participate and examine differences in attribute preferences between four distinct groups classified in the previous study. Results of the hierarchical Bayesian (HB) estimation indicated that cost per month was the most important attribute followed by the number of meals supplemented, enrollment and eligibility requirements, program model, and inclusion of additional services. Among the three potential additional services provided, cooking demonstrations were the most preferred and nutrition counseling was the least preferred.

Cost per month was the most important attribute in respondents’ decision making when choosing between different food as medicine programs. This may be a result of having a greater number of levels compared to the other attributes, which has been shown to impact importance scores in CBC analyses. However, previous literature on cost sharing and health care utilization has shown that even relatively small levels, such as $1 to $5 USD, are associated with reduced uptake of vaccines, prescription medications, and preventive care services. This relationship has also been noted in the few food as medicine programs that included membership fees or co-payments, which found that cost was a barrier for utilization and retention of members. Although cost per month was the most important attribute affecting program preferences for all four groups, further evaluation revealed important differences in the impact of cost per month on decision making.

Among the previously identified groups of individuals likely to participate, the HPC group placed the least importance on cost per month when choosing a program. This group also had the only positive, albeit small, utility value for the $60 cost per month level implying a willingness to pay more than the other groups. Results from the previous study revealed that the HPC group had
the highest employment rate (86.8%) among the groups and nearly half (46.5%) had an annual household income of $75,000 or more. Additionally, more than 90% of the HPC group indicated a higher likelihood of participation. These results imply that members of this group may have greater economic stability and are less impacted by the cost of participation, which allows more focus on the added benefit of other attributes provided by a food as medicine program.

Conversely, cost per month was significantly more important in the decision-making process for the LPV group. This group had fewer married or unmarried couples, a lower employment rate, and more than half of the members had an annual household income less than $50,000. Furthermore, less than 50% of members of the LPV group indicated a higher likelihood of participation in a food as medicine program. This implies that cost may also be a driving factor for participation from this group, such that the inclusion of cost-sharing would lead to even fewer members with any likelihood of participation due to the lower economic stability. Previous literature examining the impact of cost sharing on health care utilization has found that lower-income individuals are more affected than their higher-income counterparts leading to lower utilization.\textsuperscript{222,230} Generally, lower-income households are more susceptible to fluctuations in month-to-month income than higher-income households due to issues with job security, regular occurrence of unexpected costs, and disruptions in public benefits.\textsuperscript{231–233} The development of discounted payment mechanisms (i.e., sliding scales) for lower-income groups, such as the LPV group, could have a major impact on improving their participation and utilization of food as medicine programs.

The number of meals supplemented was the second most important attribute in respondents’ decision making when choosing between food as medicine programs. The mean importance scores were comparable across groups, ranging from 14.6% to 17.7%, and each
preferred programs that supplemented 3 meals per day the most. Although preferences decreased in accordance with the number of meals supplemented for all groups, the DC group was the only group with negative utility values for the other two levels, implying that members only preferred programs that supplement 3 meals per day. This may be related to issues in the availability and accessibility of healthy foods for this group.

The DC group scored the lowest on the community availability and accessibility scale, had the fewest proportion of personal vehicle owners (76.3%) among the four groups, and experienced a high rate of food insecurity (64.4%). Previous literature has indicated that store location, distance and travel time, and availability of transportation are significant factors associated with healthy dietary behaviors.\textsuperscript{66,102} Furthermore, lack of transportation has been noted as a major barrier to participation in previous food as medicine programs.\textsuperscript{201,208,234,235} This implies that members of the DC group want to receive the maximum amount of food possible if they participate in food as medicine programs because they may experience difficulty accessing healthy food otherwise.

Mean importance scores for eligibility and enrollment requirements were comparable across the groups but indicated that the HPC group placed the most importance on the attribute. Furthermore, this group had negative utility values for the food security and no screening levels implying that members preferred chronic condition screening to be the only method for determining eligibility and enrollment. The HPC group had the highest mean number of chronic conditions compared with other groups, which may contribute to their preferences regarding eligibility and enrollment. However, this group also had the highest rate of food insecurity and mean number of children per household suggesting that there may be an underlying sense of shame about discussing their food security status. Previous literature has indicated that parents underreport socially undesirable experiences and food insecure parents are more likely to
experience some level of discomfort when discussing household food needs with health care
providers. The impact of social stigma around food security, especially in households with
children, should be considered when determining enrollment and eligibility in future programs.

Another noteworthy difference for preferences in eligibility and enrollment requirements
occurred with the LPV group, which was the only group not to prefer chronic conditions screening
the most. This group instead preferred no screening requirements were utilized for eligibility and
enrollment. This may be a result of the low mean number of chronic conditions and low rate of
food insecurity compared to other groups. Additionally, the LPV group had the highest proportion
of members indicate lower likelihood of participation suggesting inclusion of any eligibility and
enrollment criteria could be an additional barrier to participation for this group.

Among the preferences for the program model, voucher program was the least preferred
overall and across the four different groups. This is an important finding as voucher programs are
the most common type of the food as medicine program implemented and studied in the
literature. The high prevalence of voucher programs in the literature may be due to the ease
of implementation, as they likely require fewer administrative resources and time requirements
compared to food box and medically tailored meal programs. However, previous literature has
noted poor retention and redemption rates are limitations of voucher programs as both usually
decline over the duration of programs. Although no direct comparisons exist, it appears other
models may have slightly higher completion rates than voucher programs. Furthermore,
participants of previous programs have noted experiencing embarrassment, stigmatization, and
difficultly redeeming vouchers. This implies program model may be an important factor in
retention despite not being the most important attribute in initial decisions to participate in food as
medicine programs.
In individual comparisons of group preferences for different program models, the DC group had the highest importance score for the program model attribute. They were also the only group to prefer medically tailored meals over subsidized food boxes. This group had the lowest scores on home food environment and community availability and accessibility scales, which implies that obtaining healthy food may be difficult for this group. Additionally, half of the members were not part of a married or unmarried couple, and most were employed insinuating time constraints may affect their likelihood to cook at home. Previous literature has suggested being unmarried or never married, employed, and lack of access to healthy food are associated related lower home cooking frequencies.\textsuperscript{239} Thus, members of this group may find medically tailored meals more convenient than food boxes because they require less time for preparation and cooking.

The inclusion of additional services had the least importance on program preference among all attributes, but groups preferred when services were included rather than not included. The HPC group placed significantly higher importance on all three services than the other groups. This is likely related to the group placing the least importance on cost per month. Additionally, this group had relatively high levels for all socio-ecological indicators related to dietary behaviors and participation. Altogether this implies that the HPC group recognizes and understands the health benefits related to diet; thus, members of this group are more likely to seek out services that will help them achieve a healthy diet and lifestyle.

Cooking demonstrations were the most preferred additional service overall. Previous literature has noted that cooking confidence and skills are essential to diet self-efficacy and greater produce consumption at mealtimes.\textsuperscript{87,88} Participants in previous food as medicine programs have noted lack of meal planning, perceived difficulty of preparation, and lack of skills as barriers, but
confirmed the desire to learn more about these topics and seek skills to prepare tasty, healthy meals.\textsuperscript{240,241} Furthermore, participants reported continuing to use the knowledge gained from cooking classes after the programs had ended.\textsuperscript{229}

Although cooking demonstrations were the most preferred overall, the \textit{DC} group was the only group to prefer cooking demonstrations in group comparisons. This may be related to having lower scores on individual-level socio-ecological, such as self-efficacy and cooking confidence, than the \textit{SLC} and \textit{HPC} groups. However, the \textit{LPV} group had the lowest scores for these factors and preferred cooking demonstrations the least. This may be attributed to the \textit{DC} group being younger and having more employed than retired members. Previous literature has noted generational differences in cooking and meal preparation as fewer adolescents and adults report learning to cook through a formal school curriculum compared to previous generations.\textsuperscript{242–244} Thus, members of the \textit{DC} group may lack the skills and prior formal training lending to their preference for cooking demonstrations compared to other groups.

Among the other services commonly provided with food as medicine programs, the inclusion of informational material such as recipes, disease pamphlets, or diet and exercise plans was the most preferred for the \textit{SLC}, \textit{HPC}, and \textit{LPV} groups. These first two groups, \textit{SLC} and \textit{HPC}, had the highest scores on individual-level socio-ecological, such as self-efficacy and cooking confidence. This implies that they possess some similar skills or knowledge to what demonstrations and counseling may provide. The \textit{LPV} group may also have a basic set of cooking skills through formal school curriculums as mentioned earlier. Thus, these groups may perceive the most benefit from receiving recipes and other material to help them utilize their skills rather than obtaining more skills training.

The inclusion of nutritional counseling was the least preferred additional service overall.
This could be related to several factors such as limited familiarity or knowledge of nutrition education, lack of perceived need or benefit, and negative perceptions or prior interactions with the healthcare system. Participants of food as medicine programs have reported mixed knowledge and perceptions regarding the role of registered dietician nutritionists. Although previous literature on the effects of nutrition counseling is positive, some participants have reported experiencing frustration with nutrition counseling due to unrealistic or culturally inappropriate recommendations, mixed messaging from different providers, and lack of practical advice regarding skills for cooking healthy, tasty, and simple meals. Furthermore, participants who reported positive interactions also noted there was a limited amount of time for discussion and question asking when meeting with providers.

This study adds to the literature by examining overall and different groups’ preferences for food as medicine program attributes among individuals likely to participate. However, several limitations must be accounted for when considering the study results. First, this study focused on the preferences of individuals with expressed interest in food as medicine programs. This may limit generalizability to the entire U.S. population, specifically those without expressed interest in food as medicine programs. Additionally, a panel was used in data collection which may limit interpretability for some populations, like minority and underserved individuals, that are often targeted in food as medicine program research. However, quota-based sampling for age, gender, race, and ethnicity allows for some generalizability of results. Second, the CBC methods utilized to elicit program preferences are based on hypothetical programs and require respondents to choose from multiple programs. This may not be realistic of real-world situations as respondents would most likely not have the option to choose between multiple programs and instead only have one program option available. However, the methodology used is a highly regarded, standard
technique for eliciting preferences of new, and potentially unfamiliar, products or services. Lastly, the study utilized a cross-sectional design precluding any inferences of causality between sociodemographic characteristics and group membership with food as medicine program preferences. Future research should work to design, implement, and evaluate different food as medicine programs based on the preferences elicited in this study. Additionally, future studies implementing programs designed from preferences outlined in this study should perform in-depth analyses from participants and other stakeholders to further improve programs.

### 3.6 Conclusion

Initial research on food as medicine programs has shown promising results, but programs have excluded participant preferences when designing programs. The results of this study provide a deeper understanding of the food as medicine program attributes preferred by individuals likely to participate in programs. The identification of attribute preferences for socio-ecologically different populations should allow future programs to be designed and tailored to meet the needs of specific target populations. This should improve the engagement and retention of participants, and lead to increased efficacy, scalability, and sustainability of food as medicine programs.
CHAPTER 4: INDIVIDUAL VALUATIONS OF FOOD AS MEDICINE PROGRAMS
AMONG DIFFERENT SOCIO-ECOLOGICAL GROUPS: A PARTIALLY DE-BIASED
ANALYSIS OF WILLINGNESS TO PAY
4.1 Background

The prevalence of diet-related chronic diseases, like obesity, diabetes, cardiovascular disease, and certain types of cancer, has increased steadily over the past several decades in the U.S.\(^6\)–\(^{12}\) Currently, 60% of adults have one or more diet-related chronic condition and many have become a common cause of death.\(^6\)–\(^{12},\)\(^{38}\) The relationship between food and health has been well documented, with substantial evidence suggesting optimal dietary patterns reinforce a healthy lifestyle and reduce the risk of developing chronic conditions throughout life.\(^{38}\) Despite this established link, approximately a third of adults and half of children in the U.S. continue to have poor quality diets.\(^{14,}\(^{39}\)–\(^{41}\) The increasing burden of diet-related chronic conditions has compelled health care stakeholders (e.g., providers, public health advocates, researchers) to examine strategies and interventions within the healthcare system to improve diet quality for patients.

An emerging body of literature indicates that food as medicine programs are one potential solution to improve diet quality and reduce the risk of chronic conditions in patients. These programs subsidize or provide healthy food options to patients as a health care intervention to target and improve diet-related health outcomes.\(^{33}\) Previous literature exploring the impact of food as medicine programs has shown improved dietary outcomes and mixed but generally positive health-related outcomes.\(^{23}–^{31}\) These preliminary results highlight the potential for food as medicine programs to play a role in the prevention, management, and treatment of diet-related chronic conditions.\(^{32}\) Furthermore, the development of sustainable and scalable programs for deployment across the entire healthcare system could improve the overall population health and reduce the burden of chronic conditions in the U.S.\(^{33}\)

Despite encouraging outcomes, the lack of sustainable funding has been identified as a significant barrier to implement, maintain, and scale food as medicine programs.\(^{156}\) Funding to
support the research and development of food as medicine programs is primarily provided on a limited basis for pilot testing by community-based organizations, research institutions, or through private, local, and state grants. The reliance on soft funding mechanisms makes organizations vulnerable to downturns in funding and time limitations, which inhibits the ability to maintain programs over the long term. As research on food as medicine programs moves beyond the pilot testing phase, identifying funding models that consistently support the services provided by these programs is vital for widespread implementation and sustainability.

Integration into the healthcare system is the most sustainable mechanism for food as medicine programs to achieve long-term, widespread success. Traditionally, the healthcare system has not paid for access to food, but public and private insurance payers are expanding opportunities for food as medicine programs. In the public sector, Medicaid and Medicare have several promising pathways that can be used to provide funding for the delivery of food as medicine programs to low-income individuals living with or at-risk of diet-related chronic conditions. In the private sector, insurance payers are exploring and implementing their own food as medicine program to provide patients with certain chronic conditions fresh and healthy meals multiple times per week. However, before food as medicine programs are widely implemented and included as additional services by insurers, more robust long-term evidence on clinical, behavioral, and social outcomes is needed.

As more evidence is generated, understanding patients’ demand, acceptability, and value for food as medicine programs are also important. A surrogate method for eliciting these concepts is assessing patients’ willingness to pay (WTP), which is the maximum amount an individual would be willing to pay for a product or service. When considering WTP, individuals must evaluate whether the transaction for a product or service is beneficial for them and determine their
highest monetary purchase value. Thus, WTP can be understood as a monetary expression of the perceived value of a product or service being provided. WTP is commonly used in economics, but previous literature has shown increasing utilization in universal health care and healthcare policy development. Estimates of WTP for food as medicine programs can provide insight into patients’ perceived value of different programs and can be used to aid decision making in future implementation.

The utilization of WTP approaches can provide a better understanding of the value and potential demand for food as medicine programs. Information about patients’ WTP for food as medicine programs can be used to design sustainable financing mechanisms, develop pricing and cost-sharing strategies, aid in allocation of private and public resources, provide forecasting for potential populations in need, and help model demand. As such, this study intended to explore the willingness to pay for food as medicine programs among individuals with diet-related conditions likely to participate. This study used open-ended and stated preference methods to evaluate the willingness to pay for different types of programs. By understanding participants willingness to pay, cost-sharing mechanisms can be incorporated into food as medicine programs to facilitate the generation of robust long-term evidence. Cost-sharing may also be useful as future programs become integrated into the healthcare system and reimbursed by insurance providers.

4.2 Study objectives

- To examine the willingness to pay for food as medicine programs among individuals likely to participate.
- To examine differences in the willingness to pay for food as medicine programs among identified latent profiles of individuals likely to participate.
4.3 Methods

Study Design

A prospective cross-sectional study design was conducted to gather data from a nationally representative sample of U.S. adults. Data were collected via an online survey fielded through Qualtrics survey software (Qualtrics Inc., Provo, UT). Respondents’ willingness to pay for food as medicine programs was elicited through open-ended (OE) and state preference response questions. Exemption from the University of Mississippi Institutional Review Board (IRB) was given before data collection (protocol #23x-103).

Study Sample

Participants were recruited through research panels provided by Qualtrics (Qualtrics Inc., Provo, UT). A quota-based convenience sampling technique was used to ensure a nationally representative sample based on age, gender, race, and ethnicity. Panel members were eligible to participate in the study if they met the following inclusion criteria: aged 18 years or older, English-speaking, diagnosed with at least one diet-related chronic condition, and indicated a likelihood of participation in food as medicine programs. A set of screening questions was used to determine the presence of diet-related chronic conditions and the likelihood of participation. Dichotomous response questions (e.g., yes/no) were used to elicit physician diagnosis for seven diet-related chronic conditions, and a rating scale response question was used to assess the likelihood of participation. Individuals with no chronic conditions and those who were unlikely to participate in food as medicine programs were excluded from the study. A target sample of 600 respondents was recruited to participate in the study to ensure that sufficient responses were collected for analyses. Sample size was determined from previous literature providing examples of data analyses being employed.255
**Data Collection**

A self-administered survey was used to collect data for the study. The survey gathered information regarding socio-ecological predictors of dietary behavior, likelihood of participation in programs, food security, diet-related chronic conditions, sociodemographic characteristics, and willingness to pay. Data for willingness to pay was collected using two methods, OE response questions and stated preference using a choice-based conjoint (CBC) analysis. All survey items were taken or adapted from previous literature, with additional items included as necessary to meet the study objectives. The attributes for the CBC analysis were established from previous literature regarding food as medicine programs and expert opinion. The final attributes and attribute levels used were provided in the previous study. Prior to data collection, the survey was piloted with 59 graduate students to assess face and content validity, interpretability, clarity, and cognitive burden. Additional information on the number of meals supplemented and included services was added to the open-ended response questions for willingness to pay. Furthermore, an additional question about dietary restrictions was included based on feedback from pilot participants. A final version of the survey is provided in the Appendix 1 of the dissertation.

**Willingness to pay**

Various approaches have been developed to determine consumers’ WTP based on three main distinctions – direct or indirect measures of WTP, single question or multiple questions, and actual or hypothetical WTP. One method commonly used in practice asks consumers to state their WTP directly using either a single OE response question or multiple OE response questions. This method is conceptually straightforward to implement regarding data collection and analysis; however, it is susceptible to consumer-level bias. Generally, individuals answering OE questions tend to inflate their true WTP because they use a unique benchmark that
varies by individual.\textsuperscript{256,261–263} Another method becoming increasingly popular is an indirect approach using a single, dichotomous-choice (DC) response question format or multiple sequential choice questions, such as CBC analyses.\textsuperscript{259,264} These approaches have been shown to capture more realistic choice and purchase scenarios, and CBC can provide additional information on WTP for individual attributes.\textsuperscript{265–268} However, this method is susceptible to anchoring bias because individuals seize upon a price cue for the value of a product and base their stated WTP on the cue.\textsuperscript{259,269} Thus, individuals have a propensity to inflate their true WTP when faced with high price cues and underreport their true WTP when confronted with low price cues.\textsuperscript{255}

The inherent bias in the OE, DC, and CBC approaches mean none are ideal for estimating actual consumer WTP.\textsuperscript{255} However, by leveraging the different bias structures present within the separate approaches, a de-biased direct single OE question approach can be used to provide a fairly accurate estimation of actual WTP.\textsuperscript{255} Hofstetter and colleagues (2021) developed a multistep de-biasing approach that can derive an accurate estimation of actual WTP from stated WTP elicited through an OE responses question by adding three non-individual specific adjustment factors.\textsuperscript{255} The first two factors, $\tilde{p}$ and $\hat{p}$, are determined from two different biased data series collected through OE and either DC or CBC approaches.\textsuperscript{255} The third factor, $\text{cov}(\theta, p)$, is a constant number simulated from direct WTP methods, and $\epsilon_i$ is white noise.\textsuperscript{255} These factors fit into the full de-biased bias correcting function is presented in Eq. (1) below, which can derive respondent’s actual WTP.
The multistep approach outlined by Hofstetter et al. (2021) also provides a partial de-biased approach, which was used in this study. The partial de-biased approach improves estimates of actual WTP from OE question format by subtracting $\bar{p} - \hat{p}$ from the OE data series and accounting for individual-specific variations.\textsuperscript{255} This process involves determining the mean of the data series by using Eq. (1) to subtract $\bar{p} - \hat{p}$ from $\bar{p}_i$ while setting $cov(\theta, p) = 0$ and randomly drawing $\epsilon_i$ from a normal distribution with zero mean and the same standard deviation as the OE data series, $SD(\bar{p})$.\textsuperscript{255} The partial approach is suitable for this study because indirect methods are being used to determine WTP. The full approach requires using direct methods (e.g., Becker, DeGroot, and Marschak mechanism) to determine an actual WTP, which would be too cumbersome to gather in this study.\textsuperscript{255} Furthermore, the partial de-biasing approach has been shown to significantly improve estimation of actual WTP relative to the original OE data series.\textsuperscript{255} The partial de-biased correcting function utilized in this study is presented in Eq. (2) below.

\begin{equation}
\text{Eq. (2)} \quad p_i = \bar{p}_i - \bar{p} + \hat{p} - \epsilon_i
\end{equation}

In this study, three base profiles for the following program models, voucher programs, subsidized food packages, and prepared-meal delivery, were created based on common attributes identified in previous literature.\textsuperscript{144,145} The base profiles for the three different food as medicine programs are presented in Table 4.1. Respondents first stated their hypothetical WTP using an OE
Table 4.1 Summary of the Base Food as Medicine Program Profiles Utilized for Willingness to Pay Analyses

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Base Program Profile 1</th>
<th>Base Program Profile 2</th>
<th>Base Program Profile 3</th>
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</thead>
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<td>Program Model</td>
<td>Vouchers</td>
<td>Subsidized food boxes</td>
<td>Medically tailored meals</td>
</tr>
<tr>
<td>Eligibility and enrollment</td>
<td>Chronic condition screening</td>
<td>Chronic condition screening</td>
<td>Chronic condition screening</td>
</tr>
<tr>
<td>requirements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of meals supplemented</td>
<td>1 meal per day</td>
<td>1 meal per day</td>
<td>2 meals per day</td>
</tr>
<tr>
<td>Nutrition counseling</td>
<td>Included</td>
<td>Included</td>
<td>Included</td>
</tr>
<tr>
<td>Informational material</td>
<td>Included</td>
<td>Included</td>
<td>Included</td>
</tr>
<tr>
<td>Cooking demonstrations</td>
<td>Included</td>
<td>Included</td>
<td>Included</td>
</tr>
</tbody>
</table>

question format following a brief description of each food as medicine program profile to ensure full understanding of the program being assessed.

Respondents also indirectly stated their WTP through multiple sequential choice questions from CBC analyses. Five different price levels were determined using subsidy ranges identified in previous literature, which provided program participants with monetary incentives ranging from $7 to $58 per week. This range was multiplied by four to estimate a per month cost, which is how the cost will be presented, then halved to limit the number of levels to five: $0, $30, $60, $90, and $120 per month. Respondents’ WTP for the three base profiles were calculated using estimation methods outlined in previous literature of CBC analyses. Briefly, the total utility of the profile excluding the price was calculated by adding the individual attribute level utilities. The utility of not choosing the product (e.g., utility of the “none” option) was then taken from this total profile utility to determine the WTP threshold for each respondent. This WTP threshold was used to find the price level with a smaller or equal utility value. Finally, the respondents’ maximum
WTP was estimated using linear interpolation between the previously price level and the next highest price level.

**Study variables**

**Socio-ecological factors**

An adapted Socio-Ecological (SE) model for participation in food as medicine programs was used to identify latent profiles in a previous study. The model included the following socio-ecological indicators identified from previous literature: self-efficacy, attitude, cooking confidence, family and social support, cultural influence, home food environment, community availability and accessibility, and affordability of healthy food.61,72 The SE indicators were collected via previously developed survey instruments previously identified in the literature. Responses were collected using multipoint response format scales and treated continuously in the latent profile analysis. Results of the latent profile analysis identified four groups of individuals likely to participate in food as medicine programs, the *Socially-Limited Capable (SLC)* group, *High Propensity Capable (HPC)* group, *Disengaged Capable (DC)* group, and *Low Propensity Vulnerable (LPV)* group. These groups were included in the study to examine associations between group membership and attribute preferences.

**Food security**

The Six-Item Short Form Food Security questionnaire was used to determine food security status among respondents.182 Respondents were asked about their food situation in the last 30 days. The situations included affording to eat a balanced meal, purchasing more of foods that did not last, cutting or skipping meals, eating less than they should, and being hungry but not eating. Raw scale scores were calculated (range 0 to 6) and dichotomized based on food security status (food secure = 0; food insecure = 1) according to recommendations.182,183 Food security status was used
as a covariate in data analysis.

Chronic health conditions

Information about the presence of diet-related chronic conditions was collected as part of the screening process. Dichotomous response questions (e.g., yes/no) were taken from the 2020 Behavioral Risk Factor Surveillance System (BRFSS) questionnaire to elicit physician diagnoses. The BRFSS questionnaire collects data from U.S. residents regarding their health-related behaviors, conditions, and utilization of health services. The following diet-related chronic conditions were included: hypertension, hypercholesteremia, coronary artery disease, stroke, obesity, pre-diabetes, and type 2 diabetes. Individuals with at least one diagnosis were included in the study, and the number of chronic conditions was used as a covariate in data analyses.

Sociodemographic characteristics

Sociodemographic characteristics were collected using questions from the 2020 BRFSS demographic core section. The following sociodemographic characteristics were collected: 1. Age in years; 2. Gender; 3. Hispanic, Latino/a, or Spanish origin; 4. Race; 5. Marital or relationship status; 6. Level of education; 7. Annual household income; 8. Employment status; 9. Healthcare insurance status; 10. Housing arrangement; 11. Household size; 12. Number of children in household; 13. Area of residence; 14. Access to transportation; and 15. Dietary regimen or restrictions. Sociodemographic characteristics were included as covariates in data analyses.

Data analysis

Descriptive statistics were performed to summarize the overall and group sociodemographic characteristics, diet-related conditions, food security, and WTP for the study sample. Continuous variables were assessed using means and standard deviations; categorical variables were assessed using frequencies. All descriptive statistics were conducted using IBM
The partial de-biased WTP for the three food as medicine programs was determined following steps developed by Hofstetter et al. (2021). First, the indirect measures discussed above were used to collect the stated hypothetical WTP needed for $\bar{p}$ and $\hat{p}$ in Eq (2). An OE question format was used to identify $\bar{p}$ for the different food as medicine programs. The other stated hypothetical WTP, $\hat{p}$, needed for the partial de-biasing approach calculated using the CBC estimation methods discussed above. An individual-level bias factor, $\epsilon_i$, was randomly drawn for each respondent from a normal distributed set of numbers with zero mean and same standard deviation as the OE WTP responses. Lastly, these variables were used in Eq. (2) to determine the partial de-biased estimate of WTP for the three different base profiles of food as medicine programs.

After the partial de-biased WTP calculations were completed, individual respondent values were utilized to examine associations with group membership from the previously identified latent profiles. The manual Bolck, Croon, and Hagenaars (BCH) method for determining distal outcomes was used to explore associations while adjusting for study covariates. This method is recommended for complex models examining continuous distal outcomes where covariates affect the outcome and group membership variables. First, an optimal model was identified using only the latent profile indicator variables to generate the BCH weights. This step was completed in a previous study identifying the latent profiles. Then, using the BCH weights, a general auxiliary model conditional on the BCH weights was estimated to prevent profile shifts from occurring during the analysis of distal outcomes. A multivariable linear regression analysis was conducted within this previous step and utilized to assess associations between group membership and WTP while adjusting for covariates. All categorical covariates were centered prior to this step. All BCH
and regression analyses were performed in Mplus Software version 8.8. A two-sided \( p \)-value of 0.05 was used to determine statistical significance and 95% confidence intervals were reported.

### 4.4 Results

**Sample characteristics**

A total of 3,587 individuals interacted with the survey invitation distributed by Qualtrics, which resulted in 2,680 respondents beginning the survey. Of these entrants, 599 completed responses were included for data analyses in the study (22.4% response rate). The sample and group characteristics are presented in Table 4.2. The final sample of respondents was representative of the U.S. population based on gender (51.3% female), race (76.0% White; 13.0% Black; 6.2% Asian or Pacific Islander), ethnicity (18.0% Hispanic), and had a mean age of 48.5 years (SD± 17.8). Most respondents were college graduates (51.1%), married (50.8%), employed part- or full-time (56.3%), and had private health insurance (45.1%). The mean number of diet-related chronic conditions was 2.6 (SD± 1.4) and 47.6% of respondents were determined to be food insecure. Among household characteristics, most respondents had an annual household income of $50,000 or greater (57.9%), were homeowners (63.4%), and lived in urban or suburban locations (75.1%). The mean household size was 2.7 (SD± 1.4), with an average of 0.6 (SD± 0.9) children per household. The characteristics of the four distinct groups identified from the latent profile analysis are also presented in the Table 4.2. For the CBC analysis, a total of 311 (51.9%) of respondents never selected the opt-out option and 7 (1.2%) always selected the option.
Table 4.2 Demographic and household characteristics of the study sample

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Overall (N = 599)</th>
<th>Socially Limited Capable (n = 234)</th>
<th>High Propensity Capable (n = 129)</th>
<th>Disengaged Capable (n = 118)</th>
<th>Low Propensity Vulnerable (n = 118)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (SD)</td>
<td>48.5 (17.8)</td>
<td>55.4 (17.6)</td>
<td>38.2 (12.6)</td>
<td>42.5 (17.3)</td>
<td>51.9 (16.5)</td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>307 (51.3)</td>
<td>119 (50.9)</td>
<td>67 (51.9)</td>
<td>63 (53.4)</td>
<td>58 (49.2)</td>
</tr>
<tr>
<td>Hispanic Latino/a, or Spanish Ethnicity, n (%)</td>
<td>108 (18.0)</td>
<td>31 (13.2)</td>
<td>27 (20.9)</td>
<td>38 (32.2)</td>
<td>12 (10.2)</td>
</tr>
<tr>
<td>Race, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>455 (76.0)</td>
<td>174 (74.4)</td>
<td>96 (74.4)</td>
<td>91 (77.1)</td>
<td>94 (79.7)</td>
</tr>
<tr>
<td>Black</td>
<td>78 (13.0)</td>
<td>31 (13.2)</td>
<td>23 (17.8)</td>
<td>13 (11.0)</td>
<td>11 (9.3)</td>
</tr>
<tr>
<td>American Indian</td>
<td>9 (1.5)</td>
<td>4 (1.7)</td>
<td>3 (2.3)</td>
<td>2 (1.7)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Asian or Pacific Islander</td>
<td>37 (6.2)</td>
<td>18 (7.7)</td>
<td>6 (4.7)</td>
<td>6 (5.1)</td>
<td>7 (5.9)</td>
</tr>
<tr>
<td>Other</td>
<td>20 (3.3)</td>
<td>7 (3.0)</td>
<td>1 (0.8)</td>
<td>6 (5.1)</td>
<td>6 (5.1)</td>
</tr>
<tr>
<td>Highest level of education, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school or less (1st-11th)</td>
<td>5 (0.9)</td>
<td>1 (0.4)</td>
<td>1 (0.8)</td>
<td>1 (0.8)</td>
<td>2 (1.7)</td>
</tr>
<tr>
<td>High school graduate (12th or GED)</td>
<td>101 (16.9)</td>
<td>40 (17.1)</td>
<td>21 (16.3)</td>
<td>16 (13.6)</td>
<td>24 (20.3)</td>
</tr>
<tr>
<td>Some college or technical school (1-3 years)</td>
<td>187 (31.2)</td>
<td>77 (32.9)</td>
<td>17 (13.2)</td>
<td>41 (34.7)</td>
<td>52 (44.1)</td>
</tr>
<tr>
<td>College graduate (4 or more years)</td>
<td>202 (33.7)</td>
<td>71 (30.3)</td>
<td>53 (41.1)</td>
<td>47 (39.8)</td>
<td>31 (26.3)</td>
</tr>
<tr>
<td>Advanced degree graduate (e.g., M.S., Ph.D.)</td>
<td>104 (17.4)</td>
<td>45 (19.2)</td>
<td>37 (28.7)</td>
<td>13 (11.0)</td>
<td>9 (7.6)</td>
</tr>
<tr>
<td>Relationship status, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>304 (50.8)</td>
<td>126 (53.8)</td>
<td>86 (66.7)</td>
<td>47 (39.8)</td>
<td>45 (38.1)</td>
</tr>
<tr>
<td>Widowed</td>
<td>26 (4.3)</td>
<td>15 (6.4)</td>
<td>1 (0.8)</td>
<td>2 (1.7)</td>
<td>8 (6.8)</td>
</tr>
<tr>
<td>Divorced or separated</td>
<td>59 (9.8)</td>
<td>26 (11.1)</td>
<td>6 (4.7)</td>
<td>14 (11.8)</td>
<td>13 (11.0)</td>
</tr>
<tr>
<td>Single/never married</td>
<td>168 (28.0)</td>
<td>51 (21.8)</td>
<td>27 (20.9)</td>
<td>43 (36.4)</td>
<td>47 (39.8)</td>
</tr>
<tr>
<td>Unmarried couple</td>
<td>42 (7.0)</td>
<td>16 (6.8)</td>
<td>9 (7.0)</td>
<td>12 (10.2)</td>
<td>5 (4.2)</td>
</tr>
</tbody>
</table>
Table 4.2 (cont.) Demographic and household characteristics of the study sample

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Overall (N = 599)</th>
<th>Socially-Limited Capable (n = 234)</th>
<th>High Propensity Capable (n = 129)</th>
<th>Disengaged Capable (n = 118)</th>
<th>Low Propensity Vulnerable (n = 118)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment status, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed full-time or part-time</td>
<td>337 (56.3)</td>
<td>105 (44.9)</td>
<td>112 (86.8)</td>
<td>72 (61.0)</td>
<td>48 (40.7)</td>
</tr>
<tr>
<td>Unemployed</td>
<td>34 (5.7)</td>
<td>11 (4.7)</td>
<td>3 (2.3)</td>
<td>11 (9.3)</td>
<td>9 (7.6)</td>
</tr>
<tr>
<td>Stay at home parent or homemaker</td>
<td>33 (5.5)</td>
<td>18 (7.7)</td>
<td>3 (2.3)</td>
<td>5 (4.2)</td>
<td>7 (5.9)</td>
</tr>
<tr>
<td>Retired</td>
<td>143 (23.9)</td>
<td>80 (34.2)</td>
<td>9 (7.0)</td>
<td>16 (13.6)</td>
<td>38 (32.2)</td>
</tr>
<tr>
<td>Student</td>
<td>17 (2.8)</td>
<td>9 (3.8)</td>
<td>0 (0.0)</td>
<td>7 (5.9)</td>
<td>1 (0.8)</td>
</tr>
<tr>
<td>Disabled or unable to work</td>
<td>35 (5.8)</td>
<td>11 (4.7)</td>
<td>2 (1.6)</td>
<td>7 (5.9)</td>
<td>15 (12.7)</td>
</tr>
<tr>
<td>Health insurance status, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private insurance through employer or marketplace</td>
<td>270 (45.1)</td>
<td>91 (38.9)</td>
<td>79 (61.2)</td>
<td>56 (47.5)</td>
<td>44 (37.3)</td>
</tr>
<tr>
<td>Medicare</td>
<td>184 (30.7)</td>
<td>94 (40.2)</td>
<td>28 (21.7)</td>
<td>25 (21.2)</td>
<td>37 (31.4)</td>
</tr>
<tr>
<td>Medicaid</td>
<td>79 (13.2)</td>
<td>24 (10.3)</td>
<td>14 (10.9)</td>
<td>23 (19.5)</td>
<td>18 (15.3)</td>
</tr>
<tr>
<td>Other (Dual enrollment, TRICARE, Indian Health Services)</td>
<td>24 (4.0)</td>
<td>18 (7.7)</td>
<td>5 (3.9)</td>
<td>11 (9.3)</td>
<td>11 (9.3)</td>
</tr>
<tr>
<td>No health insurance</td>
<td>21 (3.5)</td>
<td>7 (3.0)</td>
<td>3 (2.3)</td>
<td>3 (2.5)</td>
<td>8 (6.8)</td>
</tr>
<tr>
<td>Mean number of diet-related chronic conditions (SD)</td>
<td>2.6 (1.4)</td>
<td>2.4 (1.3)</td>
<td>2.9 (1.7)</td>
<td>2.8 (1.4)</td>
<td>2.4 (1.2)</td>
</tr>
<tr>
<td>Mean household size (SD)</td>
<td>2.7 (1.4)</td>
<td>2.4 (1.4)</td>
<td>3.2 (1.2)</td>
<td>3.0 (1.4)</td>
<td>2.4 (1.3)</td>
</tr>
<tr>
<td>Mean number of children per household (SD)</td>
<td>0.6 (0.9)</td>
<td>0.4 (0.9)</td>
<td>1.0 (0.9)</td>
<td>0.8 (1.0)</td>
<td>0.3 (0.8)</td>
</tr>
</tbody>
</table>
Table 4.2 (cont.) Demographic and household characteristics of the study sample

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Overall (N = 599)</th>
<th>Socially-Limited Capable (n = 234)</th>
<th>High Propensity Capable (n = 129)</th>
<th>Disengaged Capable (n = 118)</th>
<th>Low Propensity Vulnerable (n = 118)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual household income, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; $10,000</td>
<td>22 (3.7)</td>
<td>5 (2.1)</td>
<td>3 (2.3)</td>
<td>6 (5.1)</td>
<td>8 (6.8)</td>
</tr>
<tr>
<td>$10,000 – $14,999</td>
<td>20 (3.3)</td>
<td>7 (3.0)</td>
<td>2 (1.6)</td>
<td>5 (4.2)</td>
<td>6 (5.1)</td>
</tr>
<tr>
<td>$15,000 – $19,999</td>
<td>24 (4.0)</td>
<td>7 (3.0)</td>
<td>4 (3.1)</td>
<td>6 (5.1)</td>
<td>7 (5.9)</td>
</tr>
<tr>
<td>$20,000 – $24,999</td>
<td>33 (5.5)</td>
<td>12 (5.1)</td>
<td>4 (3.1)</td>
<td>8 (6.8)</td>
<td>9 (7.6)</td>
</tr>
<tr>
<td>$25,000 – $34,999</td>
<td>58 (9.7)</td>
<td>31 (13.2)</td>
<td>5 (3.9)</td>
<td>10 (8.5)</td>
<td>12 (10.2)</td>
</tr>
<tr>
<td>$35,000 – $49,999</td>
<td>95 (15.9)</td>
<td>30 (12.8)</td>
<td>15 (11.6)</td>
<td>26 (22.0)</td>
<td>24 (20.3)</td>
</tr>
<tr>
<td>$50,000 – $74,999</td>
<td>160 (26.7)</td>
<td>65 (27.8)</td>
<td>36 (27.9)</td>
<td>27 (22.9)</td>
<td>32 (27.1)</td>
</tr>
<tr>
<td>$75,000 – $99,999</td>
<td>75 (12.5)</td>
<td>33 (14.1)</td>
<td>21 (16.3)</td>
<td>12 (10.2)</td>
<td>9 (7.6)</td>
</tr>
<tr>
<td>$100,000 – $149,999</td>
<td>75 (12.5)</td>
<td>28 (12.0)</td>
<td>26 (20.2)</td>
<td>13 (11.0)</td>
<td>8 (6.8)</td>
</tr>
<tr>
<td>≥ $150,000</td>
<td>37 (6.2)</td>
<td>16 (6.8)</td>
<td>13 (10.1)</td>
<td>5 (4.2)</td>
<td>3 (2.5)</td>
</tr>
<tr>
<td>Homeownership, n (%)</td>
<td>380 (63.4)</td>
<td>145 (62.0)</td>
<td>96 (74.4)</td>
<td>70 (59.3)</td>
<td>69 (58.5)</td>
</tr>
<tr>
<td>Residential location, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban or inner-city</td>
<td>199 (33.2)</td>
<td>61 (26.1)</td>
<td>68 (52.7)</td>
<td>41 (34.7)</td>
<td>29 (24.6)</td>
</tr>
<tr>
<td>Suburban</td>
<td>251 (41.9)</td>
<td>107 (45.7)</td>
<td>40 (31.0)</td>
<td>52 (44.1)</td>
<td>52 (44.1)</td>
</tr>
<tr>
<td>Rural/countryside, town or village</td>
<td>37 (6.2)</td>
<td>66 (28.2)</td>
<td>21 (16.3)</td>
<td>25 (21.2)</td>
<td>37 (31.4)</td>
</tr>
<tr>
<td>Personal vehicle ownership, n (%)</td>
<td>505 (84.3)</td>
<td>200 (85.5)</td>
<td>117 (90.7)</td>
<td>90 (76.3)</td>
<td>98 (83.1)</td>
</tr>
<tr>
<td>Food insecure, n (%)</td>
<td>285 (47.6)</td>
<td>67 (28.6)</td>
<td>98 (76.0)</td>
<td>76 (64.4)</td>
<td>44 (37.3)</td>
</tr>
<tr>
<td>Dietary regimen or restrictions, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegan</td>
<td>38 (6.3)</td>
<td>4 (1.7)</td>
<td>27 (20.9)</td>
<td>7 (5.9)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Vegetarian</td>
<td>37 (6.2)</td>
<td>8 (3.4)</td>
<td>17 (13.2)</td>
<td>12 (10.2)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Pescatarian</td>
<td>39 (6.5)</td>
<td>10 (4.3)</td>
<td>22 (17.1)</td>
<td>6 (5.1)</td>
<td>1 (0.8)</td>
</tr>
<tr>
<td>No dietary regimens or restrictions</td>
<td>485 (81.0)</td>
<td>212 (90.6)</td>
<td>63 (48.8)</td>
<td>93 (78.8)</td>
<td>117 (99.2)</td>
</tr>
<tr>
<td>Higher likelihood of participation, n (%)</td>
<td>387 (64.6)</td>
<td>159 (67.9)</td>
<td>119 (92.2)</td>
<td>63 (53.4)</td>
<td>46 (39.0)</td>
</tr>
</tbody>
</table>
Willingness to pay for food as medicine programs

The overall adjusted mean WTP values for the OE, CBC, and partial de-biased estimations are presented in Table 4.3. Results indicated respondents were WTP the most for the medically tailored meal program, which included an additional meal per day compared to the other program profiles. The OE, CBC, and partial de-biased mean WTP values for this program profile were $77.54 (SD 97.10), $78.38 (162.23), and $56.87 (SD 140.69), respectively. The WTP values for the other two programs were comparable, but results of the partial de-biased approach indicated that respondents were willing to pay $2.07 more for the food box program on average ($9.26 vs. $7.19).

Table 4.3 Adjusted Overall Willingness to Pay for Food as Medicine Programs

<table>
<thead>
<tr>
<th>Program</th>
<th>Mean Willingness to Pay (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OE</td>
</tr>
<tr>
<td>Voucher program</td>
<td>71.20 (118.40)</td>
</tr>
<tr>
<td>Food box program</td>
<td>68.41 (91.07)</td>
</tr>
<tr>
<td>Medically tailored meal program</td>
<td>77.54 (97.10)</td>
</tr>
</tbody>
</table>

Note. N = 575; OE = Open-Ended; CBC = Choice Based Conjoint; WTP = Willingness to Pay; SD = Standard deviation. Covariates adjusted for include age, gender, ethnicity, race, marital status, education, annual income, employment, insurance, homeownership, household size, number of children, rurality, vehicle ownership. Voucher program included chronic conditions screening, 1 meal per day, nutrition counseling, information material, and cooking demonstrations; food box program included chronic conditions screening, 1 meal per day, nutrition counseling, information material, and cooking demonstrations; medically tailored meal program included chronic conditions screening, 2 meals per day, nutrition counseling, information material, and cooking demonstrations. * Extreme values were winsorized to the 5th and 95th percentiles due to large variances preventing model convergence.

Association between profile membership and WTP

Results of the BCH analysis examining the association between group membership and WTP for food as medicine programs, while adjusting for covariates, are presented in Table 4.4. A comparison of the WTP estimates for the OE and CBC revealed that the HPC and SLC groups had the highest WTP values, respectively, for all three programs. In the OE response, the HPC stated they were willing to pay $93.56 (SE 21.05) for the voucher program, $90.09 (SE 18.57) for
the food box program, and $95.64 (SE 18.74) for the medically tailored meal program. The LPV group stated they were willing to pay the least for all three programs (range: $42.53 to $70.19). For the calculated WTP values from the CBC analysis, the SLC group had the highest values for all three programs (range: $111.64 to $140.00). The HPC group had the lowest WTP values for the voucher program ($62.29, SE 30.69) and food box program ($64.96, SE 31.55); and the DC group had the lowest WTP value for the medically tailored meal program ($69.89, SE 34.26).

Table 4.4 Adjusted Class-Specific Means of Distal Outcome Willingness to Pay for Food as Medicine Programs

<table>
<thead>
<tr>
<th>Program</th>
<th>Mean Willingness to Pay (SE)</th>
<th>OE</th>
<th>CBCa</th>
<th>Partial De-biased</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voucher program</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socially-Limited Capable</td>
<td>66.27 (15.07)</td>
<td>111.64 (17.24)</td>
<td>6.04 (22.88)</td>
<td></td>
</tr>
<tr>
<td>High Propensity Capable</td>
<td>93.56 (21.05)</td>
<td>62.29 (30.69)</td>
<td>26.09 (32.25)</td>
<td></td>
</tr>
<tr>
<td>Disengaged Capable</td>
<td>73.15 (24.00)</td>
<td>65.94 (31.13)</td>
<td>24.45 (34.11)</td>
<td></td>
</tr>
<tr>
<td>Low Propensity Vulnerable</td>
<td>42.53 (13.54)</td>
<td>67.05 (19.74)</td>
<td>–12.78 (24.80)</td>
<td></td>
</tr>
<tr>
<td>Food box program</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socially-Limited Capable</td>
<td>74.95 (13.74)</td>
<td>116.62 (18.54)</td>
<td>29.27 (19.27)</td>
<td></td>
</tr>
<tr>
<td>High Propensity Capable</td>
<td>90.09 (18.57)</td>
<td>64.96 (31.55)</td>
<td>49.31 (26.81)</td>
<td></td>
</tr>
<tr>
<td>Disengaged Capable</td>
<td>82.39 (19.66)</td>
<td>74.23 (32.05)</td>
<td>81.42 (27.44)</td>
<td></td>
</tr>
<tr>
<td>Low Propensity Vulnerable</td>
<td>57.51 (12.16)</td>
<td>68.58 (20.74)</td>
<td>7.60 (21.07)</td>
<td></td>
</tr>
<tr>
<td>Medically tailored meal program</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socially-Limited Capable</td>
<td>76.82 (12.90)</td>
<td>140.00 (21.82)</td>
<td>39.34 (20.16)</td>
<td></td>
</tr>
<tr>
<td>High Propensity Capable</td>
<td>95.64 (18.74)</td>
<td>91.48 (33.95)</td>
<td>63.80 (27.48)</td>
<td></td>
</tr>
<tr>
<td>Disengaged Capable</td>
<td>76.55 (19.86)</td>
<td>69.89 (34.26)</td>
<td>32.44 (27.51)</td>
<td></td>
</tr>
<tr>
<td>Low Propensity Vulnerable</td>
<td>70.19 (13.22)</td>
<td>102.82 (21.09)</td>
<td>45.07 (24.66)</td>
<td></td>
</tr>
</tbody>
</table>

Note. N = 575; OE = Open-Ended; CBC = Choice Based Conjoint; WTP = Willingness to Pay; SE = Standard Error. Adjusted for the following covariates: age, female, Hispanic, race, relationship, education, income, employment, health insurance, homeownership, household size, number of children, rurality, and vehicle ownership. Voucher program included chronic conditions screening, 1 meal per day, nutrition counseling, information material, and cooking demonstrations; food box program included chronic conditions screening, 1 meal per day, nutrition counseling, information material, and cooking demonstrations; medically tailored meal program included chronic conditions screening, 2 meals per day, nutrition counseling, information material, and cooking demonstrations. a Extreme values were winsorized to the 5th and 95th percentiles due to large variances preventing model convergence.
Comparison of the partial de-biased WTP values indicated that the HPC group was willing to pay the most for the voucher program ($26.09, SE 32.25) and medically tailored meal program ($63.80, SE 27.48). The DC group was willing to pay the most for the food box program ($81.42, SE 27.44). The LPV group had a negative WTP value for the voucher program (−$12.78, SE 24.80), implying that they would not pay at all for participation in this program. This group also had the lowest WTP for food box programs at $7.60 (SE 21.07). The food box program was the only program with a statistically significant omnibus Wald chi-square test for the partial de-biased WTP ($χ^2(3) = 11.103, p = 0.0112), indicating significant differences across the four groups.

Table 4.5 Adjusted Differences in Class-Specific Means of Distal Outcome Partial De-biased Willingness to Pay for Food as Medicine Programs

<table>
<thead>
<tr>
<th>Latent Profile</th>
<th>Mean WTP ($)</th>
<th>SLC</th>
<th>HPC</th>
<th>DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voucher program</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socially-Limited Capable</td>
<td>6.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Propensity Capable</td>
<td>26.09</td>
<td>20.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disengaged Capable</td>
<td>24.45</td>
<td>18.41</td>
<td>-1.64</td>
<td></td>
</tr>
<tr>
<td>Low Propensity Vulnerable</td>
<td>-12.78</td>
<td>-18.82</td>
<td>-38.87</td>
<td>-37.23</td>
</tr>
<tr>
<td>Food box program</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socially-Limited Capable</td>
<td>29.27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Propensity Capable</td>
<td>49.31</td>
<td>20.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disengaged Capable</td>
<td>81.42</td>
<td>52.15*</td>
<td>32.11</td>
<td></td>
</tr>
<tr>
<td>Low Propensity Vulnerable</td>
<td>7.60</td>
<td>-21.67</td>
<td>-41.71*</td>
<td>-73.82**</td>
</tr>
<tr>
<td>Medically tailored meal program</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socially-Limited Capable</td>
<td>39.34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Propensity Capable</td>
<td>63.80</td>
<td>24.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disengaged Capable</td>
<td>32.44</td>
<td>-6.90</td>
<td>-31.36</td>
<td></td>
</tr>
<tr>
<td>Low Propensity Vulnerable</td>
<td>45.07</td>
<td>5.73</td>
<td>-18.73</td>
<td>12.63</td>
</tr>
</tbody>
</table>

Note. N = 575. SLC is comparison with Socially-Limited Capable group; HPC is comparison with the High Propensity Capable group; DC is comparison with the Disengage Capable group. * Statistically significant at p ≤ 0.05; ** Statistically significant at p ≤ 0.001; Adjusted for the following covariates: age, female, Hispanic, race, relationship, education, income, employment, health insurance, homeownership, household size, number of children, rurality, and vehicle ownership.

Voucher program included chronic conditions screening, 1 meal per day, nutrition counseling, information material, and cooking demonstrations; food box program included chronic conditions screening, 1 meal per day, nutrition counseling, information material, and cooking demonstrations; medically tailored meal program included chronic conditions screening, 2 meals per day, nutrition counseling, information material, and cooking demonstrations.
Evaluation of individual pairwise comparisons for partial de-biased WTP between groups is presented in Table 4.5. The individual analyses reveal the DC group was willing to pay significantly more than the SLC group (81.42 vs. 29.27, \( p \leq 0.05 \)) and LPV group (81.42 vs. 7.60, \( p \leq 0.001 \)) for the food box program. Lastly, the HPC was willing to pay significantly more than the LPV group (49.31 vs. 7.60, \( p \leq 0.05 \)).

4.5 Discussion

This study sought to determine WTP for three different food as medicine programs among interested individuals and examine differences in WTP between the four groups identified in the previous study. Results for the overall partial de-biased WTP estimations indicated that respondents were willing to pay in some capacity for participation in food as medicine programs. Respondents were willing to pay the most, approximately $57 per month, for the medically tailored meal program that supplemented two meals per day. The overall WTP was much less for the voucher and food box programs, which only supplemented one meal per day. Further evaluation of the results examining the association of group membership and WTP revealed key differences in the valuation of food as medicine programs between groups.

All groups indicated that the voucher program had the least value of the three food as medicine programs compared, as evident by the lower WTP values. The HPC group was willing to pay the most for the voucher program, ($26.09) followed by the DC group ($24.45) and SLC group ($6.04). Notably, the LPV group had a negative WTP value for the voucher program (–$12.78) suggesting they would not be willing to pay at all for this program. This implies members of the group do not find any intrinsic value in voucher programs and participation may negatively affect their personal perceptions of themselves. Previous literature has found participants of voucher programs experienced embarrassment, stigmatization, and difficulty when redeeming
vouchers at participating retailers. The possibility of negative social interactions suggests members are comfortable continuing with the current status quo rather than participating in a voucher program. The lack of intrinsic value may also be related to the low economic stability of members compared to the other groups.

The LPV group had the fewest married or unmarried couples (42.3%) and lowest employment rate (40.7%) compared to the other groups. Additionally, more than half of the group members (55.9%) had a household income less than $50,000. Previous literature has noted that lower-income households are more susceptible to fluctuations in monthly income due to issues with employment, occurrence of unexpected costs, and disruptions in public benefits. At a very basic level, the design of voucher programs is similar to couponing because both involve using subsidies to help purchase food items at a discounted rate. The LPV group may view voucher programs from this lens and not recognize the other program attributes as added benefits. Members may instead consider participation as barrier to food access because they must endeavor unwanted visits or meetings with health care providers to receive vouchers. Thus, they are comfortable with the current status quo or would rather collect coupons on their own without the nuisance of other obligations to receive discounted food.

The results for the food box program indicated that the DC group was willing to pay the most of any group at $81.42 per month. This was significantly more than the SLC ($29.27) and LPV ($7.60) groups. The DC group was found to have the lowest scores for home food environment and community availability and accessibility scales in the previous study indicating this group may have difficulty obtaining healthy food. This group had the lowest rate of vehicle ownership compared to other groups and more than half of members had an income below $50,000, which may contribute to the accessibility issues. Previous literature has suggested store
location and hours, distance and travel time, availability of transportation, personal mobility, and access to appropriate funds are factors of accessibility and availability. Participation in a food box program may alleviate some accessibility issues the DC encounters by removing the need to locate, travel, and purchase fresh produce from a store or market. However, the DC group also had relatively a high WTP for the voucher program compared to other groups. This suggests the group values the additional services provided by food as medicine programs enough overcome accessibility issues because voucher programs would require locating and traveling to a store or market as well.

The results for the medically tailored meal program indicated that the SLC, HPC, and LPV groups valued these programs the most. Of these three groups, the HPC group had the highest WTP at $63.80 per month. This was almost $20 more than the next closest, the LPV group at $45.07 per month. The HPC group had the highest employment rate (86.8%) among the groups, and nearly half (46.5%) had an annual household income of $75,000 or more. This implies that the group had economic stability allowing them to pay the more for medically tailored meal program than other groups, which was also the case for voucher programs. These results further imply economic stability has an influential role on WTP for food as medicine programs. However, several interesting results in the WTP for medically tailored meals suggest other factors are involved as well.

First, the LPV group had the second highest WTP for medically tailored meal programs but had the lowest WTP value for the other programs. As discussed above, this group has lower economic stability than the other groups. This implies that the LPV group found additional value in the program model, or the number of meals supplemented because these were the only differentiating attributes between programs. Second, the DC group had the lowest WTP value for
the medically tailored meal program at $32.44 per month. This is a noteworthy finding as it was approximately $50 less than their WTP for the food box program, which only supplemented one meal per day. Furthermore, they were the only group not willing to pay the most for the medically tailored meal program. These results imply that irrational consumer behaviors may exist in different respondents and groups that directly influence their valuation and WTP to food as medicine programs. As such, even thoughtful consideration by researchers and practitioners regarding cost sharing does not guarantee widespread uptake by target populations.

This study adds to the literature by examining the overall and individual groups willingness to pay for three commonly implemented food as medicine programs. However, several limitations must be considered when interpreting the study results. First, this study focused on individuals with expressed interest in food as medicine programs, which may limit generalizability to the entire U.S. population. Furthermore, a panel was used in data collection potentially limiting the interpretability for minority and underserved populations. However, quota-based sampling for age, gender, race, and ethnicity provides some generalizability to general and minority populations in the U.S. Second, the willingness to pay estimations are based on stated hypothetical situations not real life situations. Additionally, food as medicine programs are not readily available services in the U.S. likely confining respondents’ knowledge and understanding of these programs to the given prompts. The methodology utilized can help control for some of the inherent bias present in willingness to pay but caution must still be taken. Lastly, the study utilized a cross-sectional design precluding any inferences of causality between group membership and willingness to pay for food as medicine programs.

4.6 Conclusion

An emerging body of literature indicates that food as medicine programs can improve diet
quality and reduce the risk of chronic conditions. However, the lack of sustainable funding mechanisms inhibits the longevity needed for programs to achieve meaningful health outcomes. The results of this study provide insights into potential participants’ willingness to pay for food as medicine programs. The identification of willingness to pay for socio-ecologically different populations should allow future programs to develop and incorporate cost-sharing mechanisms that improve the sustainability and scalability of programs. This should lead to more robust, long-term evidence on clinical, behavioral, and social outcomes needed to get programs incorporated into the U.S. healthcare system.
CHAPTER 5: DISSERTATION SUMMARY, PRACTICAL IMPLICATIONS, AND FUTURE DIRECTIONS
5.1 Dissertation summary

The increasing burden of diet-related chronic conditions in the U.S. has compelled public health advocates, researchers, and health care providers to explore strategies within the healthcare system to address this issue. An emerging body of literature indicates that food as medicine programs are one potential solution. Initial research on these programs has shown encouraging evidence for improvements in dietary outcomes among participants, but health-related outcomes have been mixed.\(^1\)\(^{-3}\) These inconsistent findings in health-related outcomes have been attributed to substantial heterogeneity in the design and duration of programs.\(^{144,154}\) Improved uniformity and consistency in food as medicine programs should generate more robust evidence. However, homogeneity alone will not assure success. Food as medicine programs must also be responsive to the individual, social, and structural contexts affecting the population where programs are being implemented. The identification of effective models, services, and implementation methods to meet the needs of specific populations is necessary to guide the strategic development and standardization of food as medicine programs.\(^{143,156,171}\)

This dissertation sought to address these unmet needs by classifying interested individuals, examining program preferences, and exploring the potential for cost-sharing mechanisms. First, socio-ecological factors were used to identify target populations of individuals interested in food as medicine programs. Then preferences for program attributes and design were compared across the different target populations. Finally, the willingness to pay for participation in three distinct programs was assessed among the target population. The identification of target populations and examination of preferences provides the opportunity to develop tailored food as medicine programs, which should increase engagement, improve health-related outcomes, and support the uptake of interventions by the healthcare system.
The first study of this dissertation, Chapter 2, demonstrated four socio-ecologically different groups of individuals interested in food as medicine programs exist— the Socially-Limited Capable (SLC) group, High Propensity Capable (HPC) group, Disengage Capable (DC) group, Low Propensity Vulnerable (LPV) group. Furthermore, the results indicated that differences were present in the proportion of members with higher likelihood of participation in the food as medicine programs. The SLC and HPC groups had the largest proportion of members indicating a higher likelihood of participation at 77% and 93%, respectively. These groups had high individual- and physical environment-level indicators of healthy dietary behaviors, but the SLC group had notably lower levels of social environment-level indicators.

Compared to the SLC and HPC groups, significantly fewer members of the DC and LPV groups indicated a higher likelihood of participation. These groups generally had lower socio-ecological indicators for all three levels; however, the DC group had higher social environment-level indicators than the SLC group. These results imply that socio-ecological factors play a role in food as medicine program participation. Among the different factors, the individual-level appears to have the most impact on participation; social environment-level factors are present but influence groups differently; and physical environment-level factors appeared to have the least influence compared to other factors.

The second study, Chapter 3, determined preferences for food as medicine program attributes among the four groups identified in the previous study. Overall, cost per month was found to be the most important attribute followed by the number of meals supplemented, enrollment and eligibility requirements, and program model. The major impact of cost per month was not surprising, as even small levels of cost-sharing have been noted to inhibit utilization and retention in previous programs.228,229 All groups preferred the lower cost levels of $0 and $30 per
month compared to the higher levels. The LPV group placed most importance on cost when choosing a program, whereas cost had significantly less importance to the HPC group. These groups had key differences related to economic stability and likelihood to participate, which presumably factored into the importance each placed on this attribute.

Preferences for the number of meals supplemented revealed that each group wanted more than one meal per day. Furthermore, the DC group was the only group not to have some preference for two meals per day. The results of the previous study implied that barriers to availability and accessibility of healthy food may exist for this group, which likely influenced the preference to supplement the maximum number of meals. Screening for chronic conditions was the most preferred eligibility and enrollment requirement for each group except for the LPV group, which preferred no screening. This group had fewer chronic conditions, lower rates of food insecurity, and lower likelihood of participation compared with the other groups, implying that inclusion screening may be a potential barrier for the group. Among the program models, the voucher program was the least preferred by all four groups. This is an important finding as voucher programs are the most common type of food as medicine program implemented in the literature.\textsuperscript{144,145} The DC group had the highest importance score for the program model and was the only group to prefer medically tailored meals over subsidized food boxes.

The inclusion of additional services had the least importance on program preference, but groups preferred when services were included. The HPC group placed significantly higher importance on all three services than the other groups. This group had the high socio-ecological factors, which implies that they recognize the benefits related to diet and seek out services to achieve a healthy diet. Overall, cooking demonstrations were preferred followed by informational handouts and nutrition counseling. The DC group was the only group to prefer cooking
demonstrations in group comparison. The inclusion of informational material such as recipes, disease pamphlets, or diet and exercise plans was the most preferred for the other three groups. This second study provided a deeper understanding of the food as medicine program attributes preferred by individuals likely to participate in programs. Furthermore, it highlighted differences in program attribute preferences among different target populations. The results should allow programs to be designed and tailored to meet the needs of specific populations. These more tailored programs should improve participant engagement and lead to increased efficacy of food as medicine programs.

The final study, Chapter 4, examined the willingness to pay for food as medicine programs among the previously identified groups. The results indicated that respondents were willing to pay in some capacity for participation in food as medicine programs but valued the medically tailored meal program supplementing two meals per day the most. All four groups had the lowest willingness to pay for the voucher program, with the HPC group willing to pay the most at $26.09 per month. Notably, the LPV group had a negative WTP value for the voucher program (–$12.78), implying that they found no intrinsic value in the program and would not pay for participation. This unwillingness to pay could be related to negative personal perceptions regarding participation, low economic stability, or lack of perceived value beyond the status quo. The DC group was willing to pay the most for the food box program, $81.42, followed by the HPC group ($49.31) and SLC group ($29.27). Participation in this type of program may alleviate the potential accessibility issues the DC group may encounter by removing the need to locate, travel, and purchase fresh produce from a store or market.

Lastly, the medically tailored meal program was valued the most by the HPC, LPV, and SLC groups. These groups were willing to pay more for participation in this program than the other
two options. The \textit{LPV} group was willing to pay substantially more for this program than the other programs, indicating that the group found additional value in the model or number of meals supplemented, as these were the only different attributes. Interestingly, the \textit{DC} group had the lowest WTP value for the medically tailored meal program, which was considerably less than their WTP for the food box program. This implies that irrational consumer behaviors may impact the valuation and WTP for food as medicine programs, and even thoughtful consideration around cost-sharing does not guarantee uptake. Overall, the results provide insight into the potential demand, acceptability, and value of food as medicine programs from the perspective of potential participants. The willingness to pay for participation in some capacity highlights the potential to develop and implement cost-sharing mechanisms to improve the sustainability of programs.

Although initial research on food as medicine programs has produced encouraging results for dietary and health-related outcomes, more robust evidence is needed to promote widespread uptake of programs in the U.S. healthcare system. This dissertation provides a deeper understanding of the heterogeneity of individuals likely to participate and their preferences for the design of food as medicine programs. The results allow the design and implementation of future programs to be customized for the needs of specific patient populations. This should lead to increased acceptability, better engagement and retention, improved outcomes, and better overall consistency among programs.

\textbf{5.2 Practical implications}

Food as medicine programs have gained significant attention in recent years, with growing evidence supporting the potential benefits of these programs to improve dietary and health-related outcomes. As research moves beyond the conceptual stages, an increased focus on patient-centered research in the design and implementation of food as medicine programs is vital. This approach
prioritizes the perspectives, preferences, and needs of the individuals who will directly participate in these programs, which can enhance the relevance, acceptability, and effectiveness of these programs. The findings from this dissertation provide valuable insights into the practical implications of identifying target populations, understanding their preferences, and determining their willingness to pay for participation in food as medicine programs.

The identification of four distinct socio-ecological groups provides a foundation for tailoring programs for target populations interested in food as medicine programs. The different characteristics and levels of interest in participating highlights the importance of recognizing heterogeneity among potential program participants. Furthermore, the notable difference among groups implies that no one-size-fits-all approach will be effective. Food as medicine programs must be tailored to specific target populations for better alignment with their needs, preferences, and contextual factors affecting dietary behaviors. By understanding the characteristics of different target populations, food as medicine programs can be designed to meet their needs, leading to improved acceptability and increased engagement.

The examination of preferences for food as medicine programs across groups provides valuable insight into the essential attributes and key areas for differentiation among target populations. Cost per month was consistently identified as the most important attribute among all groups, emphasizing the need for affordable or subsidized programs to increase utilization and retention. The number of meals supplemented was also a significant factor, with all groups preferring more than one meal per day. This implies that supplementing multiple meals can enhance the potential impact of food as medicine programs on improving diet quality and health-related outcomes. The key differentiators among groups were preferences for eligibility and enrollment requirements and additional services provided, which highlights the importance of
tailoring these attributes to the needs of the target population. This will reduce the potential for barriers and increase the value of the programs for the population, which should lead to improved engagement and increased benefits for participants.

Finally, the evaluation of willingness to pay for participation allows food as medicine programs to begin exploring cost-sharing mechanisms to promote sustainability. The findings indicate that interested individuals are generally willing to pay in some capacity for the three models. However, the value each group placed on the programs varied, highlighting the impact of individual and contextual factors on willingness to pay. Low-income individuals or those with limited economic stability may struggle to afford participation in food as medicine programs. An assessment of economic feasibility and affordability among target populations before the implementation of cost-sharing mechanisms is essential to promote accessibility. The development of alternative funding models, such as sliding scales based on income, can also increase the equitability and accessibility of food as medicine programs.

Overall, the implications of this dissertation highlight the importance of understanding the characteristics, preferences, and willingness to pay within the target population when designing and implementing food as medicine programs. By tailoring interventions to meet the needs of specific populations, programs can increase the engagement and retention of participants. Ultimately, this should lead to improved health-related outcomes and increased sustainability of food as medicine programs.

5.3 Future directions

This dissertation identified target populations of individuals interested in food as medicine programs, examined their preferences for program attributes, and explored their willingness to pay for participation. However, further research is needed to build upon the findings to continue
improving the design and implementation of food as medicine programs. The findings from this dissertation can be used as a foundation to develop and guide the implementation of sustainable programs tailored to specific target populations. As such, there are several key directions for future research that will build upon these results and enhance the potential of food as medicine programs to improve health-related outcomes.

First, more in-depth qualitative analyses of participant experiences should be conducted to gain a better understanding of the factors influencing engagement, adherence, and behavior change. This dissertation and the dearth of previous literature exploring participant perspectives highlight the need for increased awareness of the socio-ecological and contextual factors that impact program outcomes. The increased knowledge in these areas can continue to inform the identification of target populations and development of tailored interventions that address health disparities and promote equity.

In addition to qualitative analyses, longitudinal studies should be conducted to evaluate changes in group membership and socio-ecological factors over time. Individuals' perceptions and characteristics may evolve throughout different life stages, influencing their engagement and adherence to food as medicine programs. Examination of these changes can inform the development of programs responsive to the evolving needs and preferences of participants. The increased responsiveness of food as medicine programs should promote the sustained behavior changes needed to improve long-term health-related outcomes. Additionally, exploring changes in socio-ecological factors before and after program participation can provide valuable insights into the broader impacts of programs on social and environmental determinants of health.

Future research should also focus on designing, implementing, and evaluating food as medicine programs based on the preferences identified in the dissertation. Programs tailored to
meet the preferences of the intended target populations can enhance participant engagement, which should lead to improved dietary behaviors and health-related outcomes. Public health advocates, researchers, and health care providers must consider the specific needs, cultural contexts, and socioeconomic factors impacting their population to ensure relevance and effectiveness. In-depth analyses from the perspectives of participants throughout the implementation process, especially during development and evaluation, will provide invaluable feedback to improve programs. This iterative approach will ensure that food as medicine programs effectively meet the needs and preferences of the intended participants.

Finally, the engagement of other stakeholders in program evaluation will be critical for enhancing program effectiveness and impact. The perspectives of program administrators, health care providers, policymakers, and other relevant stakeholders are essential to provide a deeper understanding of the implementation process. By incorporating their diverse perspectives and expertise along with participants, researchers can develop comprehensive, culturally sensitive, and sustainable interventions. The engagement of all stakeholders facilitates the identification of barriers, facilitators, and implementation strategies that maximize program reach and effectiveness. This collaborative approach fosters ownership and empowers implementors, which can contribute to the long-term success and sustainability of food as medicine programs.

The success of food as medicine programs relies on continued research to improve the development and implementation of these programs. The examination of participant experiences, longitudinal outcomes, tailored program designs, and stakeholder perspectives are important directions for future research. An increased focus on these areas through patient-centered and interdisciplinary methodologies will ensure the full potential of programs is realized. In turn, this will facilitate the successful integration of food as medicine programs into the healthcare system.
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APPENDICES
APPENDIX 1: Dissertation Study Survey Questionnaire

Study Title: Understanding the Profiles, Preferences, and Valuations of Individuals Likely to Participate in Food as Medicine Programs

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(662) 915-2475

Key Information for You to Consider

Description: Food as medicine programs provide access to healthy foods that are tailored to meet specific needs of individuals living with or at risk for serious health conditions affected by diet. The purpose of this research project is to identify target populations of individuals likely to participate in these programs, assess their preferences regarding program design, and determine their willingness to pay for participation in programs. We are asking for your participation by completing the survey to the best of your ability. The survey includes questions about individual, social, and community factors affecting your ability to eat healthy, your preferences for attributes of food as medicine programs, and your willingness to pay for three different program models. The information gathered from this survey will help researchers and healthcare decision-makers better understand patient preferences, which will help create food as medicine programs to better meet patients' needs.

Duration and Administration: This survey should take approximately 25 to 30 minutes to complete. It is recommended you take the survey using a desktop computer, laptop, or tablet. The survey can also be taken on mobile device if needed.

Cost and Payments: There are no costs for participating in this survey. You will be compensated for completing this survey.

Risks and Benefits: No risks or benefits are anticipated in the completion of this survey.

Why you may not want to participate: You do not have time to complete this survey or are not interested in food as medicine programs.
**Why you may want to participate:** Your participation is entirely voluntary. Some benefits include helping a student complete their degree requirements for graduation, increasing the available research on food as medicine programs, and ensuring patient preferences are included in the design and implementation of future programs.

**Confidentiality:** This survey is anonymous and no identifiable information will be collected. All information collected will remain confidential and only the research team will have access to the data you provide. All data will be analyzed in aggregate, so it will not be possible for anyone to associate you with your responses.

**Right to Withdraw:** Participation in this study is completely voluntary. You do not have to take part in this study, and you may stop participation at any time. If you start the study and decide that you do not want to finish, you may simply exit the survey.

**IRB Approval:** This study has been reviewed by The University of Mississippi’s Institutional Review Board (IRB). If you have any questions, concerns, or reports regarding your rights as a participant of research, please contact the IRB at (662) 915-7482 or irb@olemiss.edu.

By clicking the 'next' button, I consent to taking this survey.

**SCREENING QUESTIONS**

1. How old are you today (in years)?
   a. _______________________

2. Do you currently live in the United States?
   a. Yes  
   b. No

The next set of questions will ask about health conditions you may have been diagnosed with or told you had by a doctor, nurse, or other health care professional. This information will help us better understand your responses to this survey.

3. Has a doctor, nurse, or other health care professional ever diagnosed or told you that you have high blood pressure or hypertension?
   a. Yes  
   b. No

4. Has a doctor, nurse, or other health care professional ever diagnosed or told you that you have high cholesterol or hypercholesteremia?
   a. Yes  
   b. No
5. Has a doctor, nurse, or other health care professional ever diagnosed or told you that you have coronary artery or heart disease?
   a. Yes
   b. No

6. Has a doctor, nurse, or other health care professional ever diagnosed or told you that you had a stroke?
   a. Yes
   b. No

7. Has a doctor, nurse, or other health care professional ever diagnosed or told you that you are obese?
   a. Yes
   b. No

8. Has a doctor, nurse, or other health care professional ever diagnosed or told you that you have pre-diabetes?
   a. Yes
   b. No

9. Has a doctor, nurse, or other health care professional ever diagnosed or told you that you have Type 2 diabetes?
   a. Yes
   b. No

**SOCIODEMOGRAPHIC SECTION**
The next section will ask about your sociodemographic characteristics. This information will help us better understand your responses in this survey. Please select the appropriate response from choices provided. There are no wrong answers.

10. What gender do you identify with?
    a. Male
    b. Female
    c. Non-binary or third gender
    d. Prefer not to answer

11. Are you Hispanic Latino/a, or Spanish origin?
    a. Yes
    b. No

12. Which of the following do you most identify as?
    a. Mexican, Mexican American, Chicano/a
    b. Puerto Rican
    c. Cuban
    d. Other Hispanic, Latino/a, or Spanish origin
13. What is race do you most identify with?
   a. White
   b. Black or African American
   c. American Indian or Alaska Native
   d. Asian
   e. Native Hawaiian or Pacific Islander
   f. Other

14. What is your current relationship or marital status?
   a. Married
   b. Widowed
   c. Divorced
   d. Separated
   e. Single/Never married
   f. Member of an unmarried couple

15. What is the highest grade or year of school you have completed?
   a. Never attended school or only attended kindergarten
   b. Elementary (Grades 1st to 8th)
   c. Some high school (Grades 9th to 11th)
   d. High school graduate (Grade 12th or GED)
   e. Some college or technical school (1 to 3 years of college)
   f. College graduate (Bachelor's degree)
   g. Advanced degree graduate (Master's degree or Doctorate)

16. What is your annual household income from all sources (i.e., total yearly salary of every individual member in your household)?
   a. Less than $10,000
   b. $10,000 - $14,999
   c. $15,000 - $19,999
   d. $20,000 - $24,999
   e. $25,000 - $34,999
   f. $35,000 - $49,999
   g. $50,000 - $74,999
   h. $75,000 - $99,999
   i. $100,000 - $149,999
   j. More than $150,000
17. Which describes your current employment status?
   a. Employed full time (>30 hours/week)
   b. Employed part time
   c. Homemaker or stay-at-home parent
   d. Unemployed for less than 1 year
   e. Unemployed for 1 year or more
   f. Retired
   g. Student
   h. Disabled or unable to work

18. Which describes your current type of primary health insurance?
   a. Insurance plan purchased through an employer, union, or spouse's employer
   b. Insurance plan purchased through the Marketplace
   c. Medicare
   d. Medicaid or other state program (e.g., CHIP)
   e. Medicaid and Medicare Dual Eligibility
   f. TRICARE, VA, or military related health insurance
   g. Alaskan Native, Indian Health Service, or Tribal Health Service
   h. Other state sponsored or governmental program
   i. I do not have health insurance

19. Which describes your current home residence or living arrangement?
   a. Own your residence/home
   b. Rent your residence/home
   c. Other arrangements (e.g., group home, staying with friends or family rent-free)

20. How many people (i.e., adults and children), including yourself, currently live in your household? If you live alone then input 1 (one).
   a. __________________________

21. How many children less than 18 years of age live in your household? If no children are present then input 0 (zero).
   a. __________________________

22. Which describes the location or area where you currently live?
   a. Urban or inner-city area
   b. Suburban area
   c. Town or village
   d. Rural or countryside area
23. What is your primary mode of transportation?
   a. Personal vehicle (e.g., car, van, truck)
   b. Ride sharing with friends, relatives, or neighbors
   c. Public transit (e.g., train, bus)
   d. Community para-transit services
   e. Taxi or ride-sharing services (e.g., Uber, Lyft)
   f. Bicycle
   g. Walking

24. Which of the following, if any, describes your dietary regimen or restrictions?
   a. Vegan
   b. Vegetarian
   c. Pescatarian (i.e., no meat except fish and/or shellfish)
   d. None of the above

PARTICIPATION IN FOOD AS MEDICINE PROGRAMS
Food as medicine programs provide patients access to healthy foods (e.g., fruits and vegetables) that are tailored to meet specific health care needs for the treatment and prevention of diet-related chronic health conditions, like diabetes, blood pressure, or heart disease. These programs are typically implemented at hospitals or clinics, and directed by doctors, nurses, dietitians, or other health care providers. Patients must be referred by a health care provider based on personal and clinical characteristics to be enrolled in food as medicine programs. Depending on the program design, patients may be provided coupons to use at local grocery stores, pre-packaged boxes of healthy food, medically-tailored ready to eat meals, or discounts at local farmer’s markets. These programs may also provide additional services like cooking demonstrations, health and nutrition counseling, diet and exercise tips, or recipes. Most programs provide the services at no cost or low cost to patients.

25. After reading the description above, please indicate your likelihood to participate a food as medicine program if it were provided in your community.
   a. Extremely unlikely
   b. Very unlikely
   c. Somewhat unlikely
   d. Neither likely nor unlikely
   e. Somewhat likely
   f. Very likely
   g. Extremely likely

OPEN-ENDED WILLINGNESS TO PAY
The next section will provide brief descriptions for three different food as medicine program models and ask you to provide your willingness to pay, in dollars ($), for participation in each program. Willingness to pay is the maximum price ($) you would be willing to pay to receive a product or service. This information will help us better understand the value of each program model to consumers. Please answer honestly.
**Voucher food program**
This program would provide patients with redeemable vouchers or coupons for a specified dollar amount ($), to purchase produce (i.e., fruits, vegetables) at pre-specified locations. Locations would include local participating grocery stores, supermarkets, farmers’ markets, or mobile markets. The vouchers provided would allow participants to purchase enough produce or healthy food to supplement 1 meal per day. Additionally, health services like cooking demonstrations, health and nutrition counseling, diet and exercise tips, and recipes would be provided. Patients would be screened and enrolled in the program by a doctor or other health care professional based on their chronic health conditions (e.g., cardiovascular disease, diabetes, obesity, etc.).

26. What is the maximum price, in dollars ($), you would be willing to pay to participate in this voucher food program if available in your community? Please input a single dollar amount ($), not a range
   a. __________________________

**Pre-assembled food box program**
This program would provide a box of predetermined healthy foods, including produce, to patients. Boxes may be developed for specific disease-related diets, like cardiovascular disease or diabetes, if needed. The boxes provided would supply enough produce or healthy food to supplement 1 meal per day. Additionally, health services like cooking demonstrations, health and nutrition counseling, diet and exercise tips, and recipes would be provided. Patients would be screened and enrolled in the program by a doctor or other health care professional based on their chronic health conditions (e.g., cardiovascular disease, diabetes, obesity, etc.).

27. What is the maximum price, in dollars ($), you would be willing to pay to participate in a pre-packaged food box program implemented in your community? Please input a single dollar amount ($), not a range
   a. __________________________

**Medically tailored meal program**
This program would provide prepared, ready-to-cook high quality meals to patients. The meals would be developed for specific disease-related diets, like cardiovascular disease or diabetes, and created under the supervision of a registered dietitian. The program would provide patients with 2 meals per day to meet their dietary needs. Additionally, health services like cooking demonstrations, health and nutrition counseling, diet and exercise tips, and recipes would be provided. Patients would be screened and enrolled in the program by a doctor or other health care professional based on their chronic health conditions (e.g., cardiovascular disease, diabetes, obesity, etc.).

28. What is the maximum price, in dollars ($), you would be willing to pay to participate in a medically tailor meal program implemented in your community? Please input a single dollar amount ($), not a range
   a. __________________________
DIET SELF-EFFICACY
The next section will ask about your dietary self-efficacy or the confidence you have in motivating yourself to make certain food consumption changes consistently for at least 6 months. This information will help us better understand the individual or personal factors that may affect participation in food as medicine programs. Please carefully consider these dietary changes and answer to the best of your ability, even if you are not planning or trying to change your eating habits. There are no wrong answers.

Whether you are trying to change your eating habits or not, please rate how confident you are that you could motivate yourself to do things like these consistently, for at least 6 months.

29. Eat fruits and/or vegetables every day at most meals.
   a. Not at all confident
   b. Slightly confident
   c. Moderately confident
   d. Very confident
   e. Extremely confident

30. Include more “healthy” fats in your diet.
   a. Not at all confident
   b. Slightly confident
   c. Moderately confident
   d. Very confident
   e. Extremely confident

31. Eat more 100% whole grain foods.
   a. Not at all confident
   b. Slightly confident
   c. Moderately confident
   d. Very confident
   e. Extremely confident

32. Eat more low- and nonfat dairy products.
   a. Not at all confident
   b. Slightly confident
   c. Moderately confident
   d. Very confident
   e. Extremely confident

33. Stick to low fat, low salt foods when you feel depressed, bored, or tense.
   a. Not at all confident
   b. Slightly confident
   c. Moderately confident
   d. Very confident
   e. Extremely confident
34. Stick to low fat, low salt foods when there is high fat, high salt food readily available (e.g. at a party).
   a. Not at all confident  
   b. Slightly confident 
   c. Moderately confident  
   d. Very confident  
   e. Extremely confident

35. Stick to low fat, low salt foods when dining with friends or coworkers.
   a. Not at all confident  
   b. Slightly confident 
   c. Moderately confident  
   d. Very confident  
   e. Extremely confident

36. Stick to low fat, low salt foods when you are alone, with no one to watch you.
   a. Not at all confident  
   b. Slightly confident 
   c. Moderately confident  
   d. Very confident  
   e. Extremely confident

37. Eat smaller portions.
   a. Not at all confident  
   b. Slightly confident 
   c. Moderately confident  
   d. Very confident  
   e. Extremely confident

38. Eat salads for lunch.
   a. Not at all confident  
   b. Slightly confident 
   c. Moderately confident  
   d. Very confident  
   e. Extremely confident

39. Avoid adding salt at the table.
   a. Not at all confident  
   b. Slightly confident 
   c. Moderately confident  
   d. Very confident  
   e. Extremely confident
40. Skip dessert, even if other people are eating it.
   a. Not at all confident
   b. Slightly confident
   c. Moderately confident
   d. Very confident
   e. Extremely confident

41. Substitute low or non-fat milk for whole milk.
   a. Not at all confident
   b. Slightly confident
   c. Moderately confident
   d. Very confident
   e. Extremely confident

42. Cut down on gravies and cream sauce.
   a. Not at all confident
   b. Slightly confident
   c. Moderately confident
   d. Very confident
   e. Extremely confident

43. Eat baked or grilled poultry and fish instead of red meat at dinner.
   a. Not at all confident
   b. Slightly confident
   c. Moderately confident
   d. Very confident
   e. Extremely confident

44. Cook from basic ingredients (e.g. fresh vegetables, whole grains, raw chicken).
   a. Not at all confident
   b. Slightly confident
   c. Moderately confident
   d. Very confident
   e. Extremely confident

**ATTITUDE TOWARDS HEALTHY EATING**
The next question asks about your attitude toward healthy eating. This information will help us better understand the individual or personal factors that may affect participation in food as medicine programs. Please carefully consider the statement and answer to the best of your ability. There are no wrong answers.
45. Please indicate the extent to which you agree or disagree with the following statement: “It is important to me that the foods I usually eat are healthy”
   a. Strongly disagree  
   b. Disagree  
   c. Somewhat agree  
   d. Agree  
   e. Strongly agree

COOKING CONFIDENCE
The next section will ask about your cooking self-efficacy or the confidence you have in performing certain food preparation and cooking activities. This information will help us better understand the individual or personal factors that may affect participation in food as medicine programs. Please carefully consider these activities and answer to the best of your ability. There are no wrong answers.

Indicate the extent to which you feel confident about performing each of the following activities at home using basic preparation and cooking techniques

46. Chopping and slicing food items by hand (basic knife skills)
   a. Not at all confident  
   b. Somewhat confident  
   c. Moderately confident  
   d. Very confident  
   e. Extremely confident

47. Steaming food items for consumption
   a. Not at all confident  
   b. Somewhat confident  
   c. Moderately confident  
   d. Very confident  
   e. Extremely confident

48. Sautéing or stir-frying food items for consumption
   a. Not at all confident  
   b. Somewhat confident  
   c. Moderately confident  
   d. Very confident  
   e. Extremely confident

49. Grilling food items for consumption
   a. Not at all confident  
   b. Somewhat confident  
   c. Moderately confident  
   d. Very confident  
   e. Extremely confident
50. Poaching or stewing food items for consumption
   a. Not at all confident
   b. Somewhat confident
   c. Moderately confident
   d. Very confident
   e. Extremely confident

51. Baking or roasting food items for consumption
   a. Not at all confident
   b. Somewhat confident
   c. Moderately confident
   d. Very confident
   e. Extremely confident

52. Preparing fresh or frozen green vegetables (e.g. cabbage, spinach, collard greens) for consumption
   a. Not at all confident
   b. Somewhat confident
   c. Moderately confident
   d. Very confident
   e. Extremely confident

53. Preparing root vegetables (e.g. potatoes, beets) for consumption
   a. Not at all confident
   b. Somewhat confident
   c. Moderately confident
   d. Very confident
   e. Extremely confident

54. Preparing fruits (e.g. watermelon, apples, strawberries, kiwi, pineapple) for consumption
   a. Not at all confident
   b. Somewhat confident
   c. Moderately confident
   d. Very confident
   e. Extremely confident

55. Using different herbs and spices (e.g. basil, cayenne pepper) when preparing food items
   a. Not at all confident
   b. Somewhat confident
   c. Moderately confident
   d. Very confident
   e. Extremely confident
FAMILY SOCIAL SUPPORT
The next two sections will ask about social support provided from family, friends, and other peers regarding health and unhealthy food consumption habits in the last 3 months. This information will help us better understand the social factors that may affect participation in food as medicine programs. Please carefully consider each statement or situation before answering to the best of your ability. There are no wrong answers.

Please indicate how often a family member or anyone living in your household, including roommates, has said or done what is described during the last 3 months.

56. Encouraged me not to eat "unhealthy foods" (cake, salted chips).
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often

57. Discussed my eating habit changes with me (asked me how I'm doing with eating healthy).
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often

58. Reminded me not to eat high fat, high salt foods.
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often

59. Complimented me on changing or maintaining my healthy eating habits ("Keep it up", "We are proud of you").
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often

60. Commented if I seemed to be reverting to unhealthy eating.
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often
61. Ate high fat or high salt foods in front of me.
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often

62. Refused to eat the healthy foods I was eating.
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often

63. Brought home foods I'm trying not to eat.
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often

64. Got angry when I encouraged them to eat low salt, low fat foods.
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often

65. Offered me food I’m trying not to eat.
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often

**PEER SOCIAL SUPPORT**
Please indicate how often friends, acquaintances, or coworkers have said or done what is described during the last 3 months.

66. Encouraged me not to eat "unhealthy foods" (cake, salted chips).
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often
67. Discussed my eating habit changes with me (asked me how I'm doing with eating healthy).
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often

68. Reminded me not to eat high fat, high salt foods.
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often

69. Complimented me on changing or maintaining my healthy eating habits ("Keep it up", "We are proud of you").
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often

70. Commented if I seemed to be reverting to unhealthy eating.
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often

71. Ate high fat or high salt foods in front of me.
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often

72. Refused to eat the healthy foods I was eating.
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often
73. Brought home foods I'm trying not to eat.
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often

74. Got angry when I encouraged them to eat low salt, low fat foods.
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often

75. Offered me food I’m trying not to eat.
   a. Never
   b. Rarely
   c. A few times
   d. Often
   e. Very often

CULTURAL INFLUENCE
The next section will ask about the impact cultural, ethnic, or religious influences may have on your food consumption habits. This information will help us better understand the social factors that may affect participation in food as medicine programs. Please carefully consider each statement or situation before answering to the best of your ability. There are no wrong answers.

Please indicate the extent to which you agree or disagree with the following statements regarding cultural, ethnic, or religious influences.

76. I have a strong sense of belonging to my cultural or ethnic group
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree

77. I feel proud of my cultural or ethnic background
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree
78. It is important for me to eat foods that are prepared in a way that is acceptable for my cultural or ethnic background
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree

79. It is important for me to eat foods that are common for my cultural or ethnic background
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree

80. It is important for me to eat foods that are prepared in a way that is acceptable for my religion
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree

81. It is important for me to eat foods that are not forbidden by my religion
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree

HOME FOOD ENVIRONMENT
The next section will ask about the availability of different food items in your household. This information will help us better understand the environmental factors that may affect participation in food as medicine programs. Please carefully consider how often these different food items are present in your household and answer to the best of your ability. There are no wrong answers.

Please indicate the extent to which you agree or disagree with the following statements about the availability of different food items in your home.

82. Fruits are regularly available in my home
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree
83. Vegetables are regularly available in my home
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree

84. Soft drinks are regularly available (Coke, Sprite, etc.) in my home
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree

85. Candy and chocolate are regularly available in my home
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree

86. Chips and salted snacks are regularly available in my home
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree

ACCESSIBILITY AND AVAILABILITY OF HEALTHY FOOD
The next section will ask about the availability and accessibility of healthy food options in the community or neighborhood where you live. This information will help us better understand the environmental factors that may affect participation in food as medicine programs. Please carefully consider the food stores in your community or neighborhood and answer to the best of your ability. There are no wrong answers. Please think of your community or neighborhood as the area within about a 30-minute walk or 10-15 minute drive from your home.

Please indicate the extent to which you agree or disagree with the following statements regarding the community or neighborhood near where you live. Think of your community or neighborhood as the area within about a 30-minute walk or 10-15 minute drive from your home.
87. It is easy to purchase fresh fruits and vegetables in my community or neighborhood.
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree

88. There is a large selection of fresh fruits and vegetables in my community or neighborhood.
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree

89. The produce in my community or neighborhood is of high quality.
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree

90. It is easy to purchase low-fat products (such as low fat milk or lean meats) in my community or neighborhood.
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree

91. There is a large selection of low-fat products available in my community or neighborhood.
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree

92. The low-fat products in my community or neighborhood are of high quality.
   a. Strongly disagree
   b. Somewhat disagree
   c. Neither agree nor disagree
   d. Somewhat agree
   e. Strongly agree
COST OF HEALTHY FOOD
The next section will ask about the cost of healthy food options at the store where you buy most of your food. This information will help us better understand the environmental factors that may affect participation in food as medicine programs. Please carefully consider the food stores where you buy food and answer to the best of your ability. There are no wrong answers.

93. How would you rate the cost of fresh fruits and vegetables the store where you buy most of your food?
   a. Very inexpensive
   b. Somewhat inexpensive
   c. Neither inexpensive nor expensive
   d. Somewhat expensive
   e. Very expensive

94. How often does the cost of fresh fruits and vegetables prevent you from purchasing them?
   a. Never
   b. Rarely
   c. Sometimes
   d. Often
   e. Always

ATTENTION CHECK
In order to facilitate our research on factors associated with the likelihood to participate in food as medicine programs, we are interested in certain factors about you. Specifically, we are interested in whether you take the time to read directions and prompts asked before questions. If not some of the results may be ineffective or provide information that is not accurate. As a demonstration that you have read the instructions, please select the option "Purple" and ignore the question below.

95. What is your favorite color?
   a. Red
   b. Blue
   c. Orange
   d. Purple
   e. Green

DISCRETE CHOICE EXPERIMENT
The next section will take you to a separate screen and present questions containing different options for food as medicine programs. There will be 13 questions total, and you will be presented 4 different options in each question. Each of these options will describe a food as medicine program consisting of 7 attributes. The attributes include program model, screening requirement, price, and additional services provided like nutrition counseling, informational material (e.g. recipes, diet plans), and cooking demonstrations.
Please note it may look like some options are the same or repeated in multiple questions, but they are all slightly different. Please carefully consider each attribute in the four options provided and choose the food as medicine program that is most preferable to you. You will be asked to do this 13 times.

**FOOD SECURITY**
The next section will ask about the food eaten in your household in the last 30 days, and whether you were able to afford the food you need. This information will help us better understand your responses in this survey. Please select the appropriate response from choices provided. There are no wrong answers.

96. In the last 30 days, the food that (I/we) bought just didn’t last, and (I/we) didn’t have money to get more.
   a. Often true
   b. Sometimes true
   c. Never true

97. In the last 30 days, (I/we) couldn’t afford to eat balanced meals.
   a. Often true
   b. Sometimes true
   c. Never true

98. In the last 30 days, did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?
   a. Yes
   b. No

99. In the last 30 days, how many times did this happen?
   a. ________________________________

100. In the last 30 days, did you ever eat less than you felt you should because there wasn't enough money for food?
   a. Yes
   b. No

101. In the last 30 days, were you every hungry but didn't eat because there wasn't enough money for food?
   a. Yes
   b. No
WTP TRANSPARENCY AND ACCEPTABILITY

102. If a voucher food program was actually offered to you by a doctor or health care provider, how certain are you that you would pay the price you previously stated to participate?
   a. Very uncertain
   b. Moderately uncertain
   c. Slightly uncertain
   d. Neither uncertain nor certain
   e. Slightly certain
   f. Moderately certain
   g. Very certain

103. If a pre-assembled food box program was actually offered to you by a doctor or health care provider, how certain are you that you would pay the price you previously stated to participate?
   a. Very uncertain
   b. Moderately uncertain
   c. Slightly uncertain
   d. Neither uncertain nor certain
   e. Slightly certain
   f. Moderately certain
   g. Very certain

104. If a medically tailored meal program was actually offered to you by a doctor or health care provider, how certain are you that you would pay the price you previously stated to participate?
   a. Very uncertain
   b. Moderately uncertain
   c. Slightly uncertain
   d. Neither uncertain nor certain
   e. Slightly certain
   f. Moderately certain
   g. Very certain

105. It is clear to me why it is in my best interest to state exactly the price I am willing to pay for a food as medicine program.
   a. Very uncertain
   b. Moderately uncertain
   c. Slightly uncertain
   d. Neither uncertain nor certain
   e. Slightly certain
   f. Moderately certain
   g. Very certain
106. I was confused about stating my maximum willingness to pay for a food as medicine program.
   a. Very uncertain
   b. Moderately uncertain
   c. Slightly uncertain
   d. Neither uncertain nor certain
   e. Slightly certain
   f. Moderately certain
   g. Very certain

107. The willingness to pay tasks were easy to understand and complete.
   a. Very uncertain
   b. Moderately uncertain
   c. Slightly uncertain
   d. Neither uncertain nor certain
   e. Slightly certain
   f. Moderately certain
   g. Very certain

108. I thought the willingness to pay tasks were fair.
   a. Very uncertain
   b. Moderately uncertain
   c. Slightly uncertain
   d. Neither uncertain nor certain
   e. Slightly certain
   f. Moderately certain
   g. Very certain

109. I would be happy to do these willingness to pay tasks again in the future.
   a. Very uncertain
   b. Moderately uncertain
   c. Slightly uncertain
   d. Neither uncertain nor certain
   e. Slightly certain
   f. Moderately certain
   g. Very certain
### APPENDIX 2: Table 2.7

Table 0.1 Predictors of latent profile membership

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>SLC vs. DC</th>
<th>HPC vs. DC</th>
<th>SLC vs. HPC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odds Ratio</td>
<td>95% LLCI</td>
<td>95% ULCI</td>
</tr>
<tr>
<td>Age&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35 – 49 years</td>
<td>1.47</td>
<td>0.42</td>
<td>5.19</td>
</tr>
<tr>
<td>50 – 64 years</td>
<td>8.96</td>
<td>1.73</td>
<td>46.43</td>
</tr>
<tr>
<td>65 years and older</td>
<td>3.51</td>
<td>0.49</td>
<td>25.25</td>
</tr>
<tr>
<td>Female&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.85</td>
<td>0.96</td>
<td>8.44</td>
</tr>
<tr>
<td>Hispanic or Spanish Ethnicity&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.33</td>
<td>0.11</td>
<td>1.04</td>
</tr>
<tr>
<td>Race&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>2.46</td>
<td>0.51</td>
<td>11.90</td>
</tr>
<tr>
<td>Other</td>
<td>1.29</td>
<td>0.37</td>
<td>4.49</td>
</tr>
<tr>
<td>Education&lt;sup&gt;e&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>College graduate</td>
<td>0.32</td>
<td>0.07</td>
<td>1.41</td>
</tr>
<tr>
<td>Advanced degree graduate</td>
<td>1.52</td>
<td>0.22</td>
<td>10.55</td>
</tr>
<tr>
<td>Relationship status&lt;sup&gt;f&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single/never married</td>
<td>0.18</td>
<td>0.05</td>
<td>0.61</td>
</tr>
<tr>
<td>Divorced/Widowed/Separated</td>
<td>0.61</td>
<td>0.20</td>
<td>1.87</td>
</tr>
<tr>
<td>Employment&lt;sup&gt;g&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployed/Student/Homemaker/Disabled</td>
<td>0.93</td>
<td>0.23</td>
<td>3.78</td>
</tr>
<tr>
<td>Retired</td>
<td>1.21</td>
<td>0.17</td>
<td>8.81</td>
</tr>
</tbody>
</table>

Note. N = 575. LLCI = Lower Level Confidence Interval; ULCI = Upper Level Confidence Interval. Statistically significant odds ratios representing prediction of latent profile membership are given in boldface; * Statistically significant at a p-value ≤ 0.05; ** Statistically significant at a p-value ≤ 0.001; <sup>a</sup>18 – 34 years used as the reference category; <sup>b</sup>No used as the reference category; <sup>c</sup>No used as the reference category; <sup>d</sup>White used as the reference category; <sup>e</sup>High school or lower used as the reference category; <sup>f</sup>MARRIED/unmarried couple used as the reference category; <sup>g</sup>Employed used as the reference category.
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>$SLC$ vs. $DC$</th>
<th>$HPC$ vs. $DC$</th>
<th>$SLC$ vs. $HPC$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odds Ratio</td>
<td>95% LL CI</td>
<td>95% UL CI</td>
</tr>
<tr>
<td>Insurance status &lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medicare</td>
<td>1.94</td>
<td>0.31</td>
<td>12.00</td>
</tr>
<tr>
<td>Medicaid</td>
<td>0.58</td>
<td>0.07</td>
<td>4.81</td>
</tr>
<tr>
<td>Other (Dual enrollment, TRICARE, IHS)</td>
<td>0.83</td>
<td>0.16</td>
<td>4.22</td>
</tr>
<tr>
<td>No health insurance</td>
<td><strong>#</strong>#<strong>#</strong>#</td>
<td><strong>#</strong>#<strong>#</strong>#</td>
<td><strong>#</strong>#<strong>#</strong>#</td>
</tr>
<tr>
<td>Number of chronic conditions</td>
<td>0.55</td>
<td>0.39</td>
<td>0.77</td>
</tr>
<tr>
<td>Household size</td>
<td>0.51</td>
<td>0.23</td>
<td>1.17</td>
</tr>
<tr>
<td>Number of children in household</td>
<td>1.39</td>
<td>0.52</td>
<td>3.74</td>
</tr>
<tr>
<td>Annual household income &lt;sup&gt;i&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$35,000 – $49,999</td>
<td>0.22</td>
<td>0.05</td>
<td>0.97</td>
</tr>
<tr>
<td>$50,000 – $74,999</td>
<td>1.73</td>
<td>0.27</td>
<td>11.18</td>
</tr>
<tr>
<td>$75,000 – $99,999</td>
<td>2.68</td>
<td>0.35</td>
<td>20.83</td>
</tr>
<tr>
<td>≥ $100,000</td>
<td>0.54</td>
<td>0.07</td>
<td>4.10</td>
</tr>
<tr>
<td>Homeownership &lt;sup&gt;j&lt;/sup&gt;</td>
<td>0.35</td>
<td>0.13</td>
<td>0.93</td>
</tr>
<tr>
<td>Rurality &lt;sup&gt;k&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suburban</td>
<td>1.08</td>
<td>0.39</td>
<td>2.95</td>
</tr>
<tr>
<td>Rural</td>
<td>2.77</td>
<td>0.88</td>
<td>8.66</td>
</tr>
<tr>
<td>Personal vehicle ownership &lt;sup&gt;l&lt;/sup&gt;</td>
<td>2.29</td>
<td>0.78</td>
<td>6.67</td>
</tr>
<tr>
<td>Food insecure &lt;sup&gt;m&lt;/sup&gt;</td>
<td>0.15</td>
<td>0.06</td>
<td>0.40</td>
</tr>
</tbody>
</table>

<sup>Note</sup>. N = 575. LLCI = Lower Level Confidence Interval; ULCI = Upper Level Confidence Interval. Statistically significant odds ratios representing prediction of latent profile membership are given in boldface. <sup>*</sup> Statistically significant at a p-value ≤ 0.05; <sup>**</sup> Statistically significant at a p-value ≤ 0.001; <sup>#</sup> Cell counts for one of the profiles were too small analyses; <sup>b</sup> Private used as the reference category; <sup>i</sup> <$35,000 used as the reference category; <sup>j</sup> No used as the reference category; <sup>k</sup> Urban used as the reference category; <sup>l</sup> No used as the reference category; <sup>m</sup> No used as the reference category.
Table 0.2 Descriptive comparison of significant sociodemographic differentiators between latent profile groups

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Socially Limited Capable (n = 234)</th>
<th>High Propensity Capable (n = 129)</th>
<th>Disengaged Capable (n = 118)</th>
<th>Low Propensity Vulnerable (n = 118)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (SD)</td>
<td>55.4 (17.6)</td>
<td>38.2 (12.6)</td>
<td>42.5 (17.3)</td>
<td>51.9 (16.5)</td>
</tr>
<tr>
<td>Age groups, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 – 34 years</td>
<td>46 (19.7)</td>
<td>59 (45.7)</td>
<td>52 (44.1)</td>
<td>23 (19.5)</td>
</tr>
<tr>
<td>35 – 49 years</td>
<td>37 (15.8)</td>
<td>49 (38.0)</td>
<td>31 (26.3)</td>
<td>30 (25.4)</td>
</tr>
<tr>
<td>50 – 64 years</td>
<td>51 (21.8)</td>
<td>14 (10.9)</td>
<td>15 (12.7)</td>
<td>26 (22.0)</td>
</tr>
<tr>
<td>65 years and older</td>
<td>100 (42.7)</td>
<td>7 (5.4)</td>
<td>20 (16.9)</td>
<td>39 (33.1)</td>
</tr>
<tr>
<td>Hispanic Latino/a, or Spanish Ethnicity, n (%)</td>
<td>31 (13.2)</td>
<td>27 (20.9)</td>
<td>38 (32.2)</td>
<td>12 (10.2)</td>
</tr>
<tr>
<td>Race, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>174 (74.4)</td>
<td>96 (74.4)</td>
<td>91 (77.1)</td>
<td>94 (79.7)</td>
</tr>
<tr>
<td>Black</td>
<td>31 (13.2)</td>
<td>23 (17.8)</td>
<td>13 (11.0)</td>
<td>11 (9.3)</td>
</tr>
<tr>
<td>Other</td>
<td>29 (12.4)</td>
<td>10 (7.8)</td>
<td>14 (11.9)</td>
<td>13 (11.0)</td>
</tr>
<tr>
<td>Relationship status, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married or unmarried couple</td>
<td>142 (60.7)</td>
<td>95 (73.6)</td>
<td>59 (50.0)</td>
<td>50 (42.4)</td>
</tr>
<tr>
<td>Single or never married</td>
<td>51 (21.8)</td>
<td>27 (20.9)</td>
<td>43 (36.4)</td>
<td>47 (39.8)</td>
</tr>
<tr>
<td>Divorced, widowed, separated</td>
<td>41 (17.5)</td>
<td>7 (5.4)</td>
<td>16 (13.6)</td>
<td>21 (17.8)</td>
</tr>
<tr>
<td>Employment status, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed full-time or part-time</td>
<td>105 (44.9)</td>
<td>112 (86.8)</td>
<td>72 (61.0)</td>
<td>48 (40.7)</td>
</tr>
<tr>
<td>Unemployed, student, homemaker, or disabled</td>
<td>49 (20.9)</td>
<td>8 (6.2)</td>
<td>30 (25.4)</td>
<td>32 (27.1)</td>
</tr>
<tr>
<td>Retired</td>
<td>80 (34.2)</td>
<td>9 (7.0)</td>
<td>16 (13.6)</td>
<td>38 (32.2)</td>
</tr>
<tr>
<td>Annual household income, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; $35,000</td>
<td>62 (26.5)</td>
<td>18 (14.0)</td>
<td>35 (29.7)</td>
<td>42 (35.6)</td>
</tr>
<tr>
<td>$35,000 – $49,999</td>
<td>30 (12.8)</td>
<td>15 (11.6)</td>
<td>26 (22.0)</td>
<td>24 (20.3)</td>
</tr>
<tr>
<td>$50,000 – $74,999</td>
<td>65 (27.8)</td>
<td>36 (27.9)</td>
<td>27 (22.9)</td>
<td>32 (27.1)</td>
</tr>
<tr>
<td>$75,000 – $99,999</td>
<td>33 (14.1)</td>
<td>21 (16.3)</td>
<td>12 (10.2)</td>
<td>9 (7.6)</td>
</tr>
<tr>
<td>≥ $100,000</td>
<td>44 (18.8)</td>
<td>39 (30.2)</td>
<td>18 (15.3)</td>
<td>11 (9.3)</td>
</tr>
<tr>
<td>Residential location, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban or inner-city</td>
<td>61 (26.1)</td>
<td>68 (52.7)</td>
<td>41 (34.7)</td>
<td>29 (24.6)</td>
</tr>
<tr>
<td>Suburban</td>
<td>107 (45.7)</td>
<td>40 (31.0)</td>
<td>52 (44.1)</td>
<td>52 (44.1)</td>
</tr>
<tr>
<td>Rural/countryside, town, or village</td>
<td>66 (28.2)</td>
<td>21 (16.3)</td>
<td>25 (21.2)</td>
<td>37 (31.4)</td>
</tr>
<tr>
<td>Homeownership, n (%)</td>
<td>145 (62.0)</td>
<td>96 (74.4)</td>
<td>70 (59.3)</td>
<td>69 (58.5)</td>
</tr>
<tr>
<td>Personal vehicle ownership, n (%)</td>
<td>200 (85.5)</td>
<td>117 (90.7)</td>
<td>90 (76.3)</td>
<td>98 (83.1)</td>
</tr>
<tr>
<td>Food insecure, n (%)</td>
<td>67 (28.6)</td>
<td>98 (76.0)</td>
<td>76 (64.4)</td>
<td>44 (37.3)</td>
</tr>
<tr>
<td>Mean number of chronic conditions (SD)</td>
<td>2.4 (1.3)</td>
<td>2.9 (1.7)</td>
<td>2.8 (1.4)</td>
<td>2.4 (1.2)</td>
</tr>
</tbody>
</table>

Note. N = 599.
Austin D. Arnold, PharmD, MBA
Curriculum Vitae
austin.d.arnold@gmail.com | www.linkedin.com/in/austindarnold

PROFESSIONAL SUMMARY
PharmD, MBA professional currently pursuing a PhD in Pharmacy Administration with demonstrated experience in the healthcare industry seeking a career in the pharmaceutical industry.

EXPERIENCE

**Graduate Research Assistant**
School of Pharmacy, Pharmacy Administration
University of Mississippi, Oxford, MS
August 2018 – Present

- Oversee and manage a Walmart Foundation funded produce prescription program to increase access to fresh produce for individuals living in a rural area of the Mississippi Delta
- Conducted research to identify patient perspectives toward an ideal weight management program
- Conducted large scoping and systemic reviews to identify key concepts, gaps in literature, and sources to improve healthcare practice and policy

**Independent Consultant**
Medical Marketing Economics, LLC, Oxford, MS
August 2019 – May 2022

- Moderated interviews with healthcare decision makers focused on market access, utilization, and pricing considerations for novel pharmaceutical products
- Collaborated with internal and external partners to develop presentations based on research findings to provide recommendations on market access and pricing strategies for pharmaceutical companies
- Provided hands-on support to wide-ranging projects through literature review, database development, data analysis, and secondary research on the epidemiology, treatment, management, and current competitor landscapes

**Data Analyst Intern**
June 2019 – August 2019

**Value Access Insights and Solutions Intern**
Takeda Pharmaceutical, Lexington, MA
June 2022 – August 2022

- Conducted a study analyzing payer preferences for pre-approval information exchange with manufacturers for rare disease products
- Developed an external slide deck for field team members to help disseminate results of a study examining healthcare resource utilization and costs of primary immunodeficiency patients initiating immunoglobulin replacement therapy
- Participated actively in workshops and meetings to develop strategic value evidence generation and dissemination plans supporting plasma-derived therapies
EXPERIENCE (cont.)

**Global Health Economics and Reimbursement Intern**
Edwards Lifesciences, Irvine, CA
- Conducted a study analyzing administrative claims data to determine potential differences between patients receiving tissue and mechanical valves in surgical aortic valve replacement procedures
- Developed clinical summaries to disseminate results from recent studies on the benefits of using tissue valves in surgical aortic valve replacement procedures
- Supported company goal of expanding the use of tissue valves in the Asia-Pacific region by developing educational materials and presentations

**Float Pharmacist**
CVS Pharmacy, Des Moines, IA
- Managed a small team of pharmacy technicians to effectively complete daily tasks, expedite the processing of prescription medications, and provide the highest quality of patient care
- Consulted prescribers and counseled patients regarding the use of prescription and over the counter medications to ensure appropriate medication use and safety

EDUCATION

**Doctor of Philosophy (Ph.D.)**
Department of Pharmacy Administration, School of Pharmacy
University of Mississippi, Oxford, MS
  Specialization: Health Economics and Outcomes Research
  Dissertation: *Who, What, and How Much: Understanding the Profiles, Preferences, and Valuations of Individuals Likely to Participate in Food as Medicine Programs*
  Anticipated May 2023

**Doctor of Pharmacy (Pharm.D.)**
College of Pharmacy & Health Sciences
Drake University, Des Moines, IA
  Honors: *cum laude*
  May 2017

**Master of Business Administration (M.B.A.)**
College of Business & Public Administration
Drake University, Des Moines, IA
  Honors: *cum laude*
  May 2017

PUBLICATIONS


PUBLICATIONS (cont.)


POSTER PRESENTATIONS

1. **Arnold A**, Rosenthal M, Cafer A, Understanding Participants’ Willingness to Pay for a Food Prescription Program in the Mississippi Delta; American Pharmacists’ Association (APhA) Annual Meeting, San Antonio, TX, March 2022


4. Clarke CL, Schott KA, **Arnold A**. Pharmacy Preceptors’ Perceived Value of Virtual Experiential Quality Assurance Visits; American Association of Colleges of Pharmacy (AACP) Annual Meeting, Anaheim, CA, July 2016

HONORS AND AWARDS

**2022-2023 Terence E. Downer Scholarship**
University of Mississippi, Oxford, MS

**2022-2023 MME Fellow Award**
University of Mississippi, Oxford, MS
HONORS AND AWARDS (cont.)

Rho Chi – Pharmaceutical Sciences Honor Society
University of Mississippi, Oxford, MS

Phi Kappa Phi – Honor Society
University of Mississippi, Oxford, MS

PROFESSIONAL LICENSURE

Iowa Pharmacist License #23115
Iowa Board of Pharmacy, Des Moines, IA
August 2017 - Present

PROFESSIONAL ASSOCIATIONS

American Pharmacists Association (APhA)
Academy of Managed Care Pharmacy (AMCP)
International Society for Pharmacoeconomics and Outcomes Research (ISPOR)

RESEARCH SKILLS

Statistical software: intermediate to advanced skills in SPSS; intermediate skills in SAS; novice skills in R, Stata, and TreeAge Pro

Real world data: intermediate skills in administrative claims data, patient reported outcomes, and statistical analysis

Quantitative research: intermediate to advanced skills in survey development, univariate and multivariate data analysis

Qualitative research: intermediate to advanced skills in guide development, interview moderation, and data analysis

Project management: advanced skills in time management, team leadership, task delegation, and project adaptability