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Uptake of Plant-Based Nutrition and Awareness among Lower Socioeconomic Status Populations in the United States

Tammy Frazier Renault
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Walden University

College of Health Sciences and Public Policy

This is to certify that the doctoral study by

Tammy Frazier Renault

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

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Walden University
2023

Abstract

Uptake of Plant-Based Nutrition and Awareness among Lower Socioeconomic Status
Populations in the United States

by

Tammy F. Renault

MPH, Kaplan University, 2016

BS, Kaplan University, 2014

Doctoral Study Submitted in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Public Health

Walden University

June 2023

Abstract

Chronic disease accounts for 86% of the annual health care expenditures in the United States. Lower socioeconomic status groups are vulnerable to the effects of nutritional deficiencies, and the connection between chronic disease and nutrition may be central to public health initiatives. The current study provided insight into the behaviors of nutritional choice for at-risk populations for many of the chronic diseases associated with nutritional education and policy which influence healthy eating patterns across multiple settings. The purpose of this quantitative study with a retrospective cross-sectional design was to observe any differences for the uptake of plant-based compliant nutrition and awareness of MyPlate nutritional guidelines by looking at whether respondents were familiar with MyPlate, looked up MyPlate on the internet or tried MyPlate with covariables income, gender, race, and education. The instrument was survey data from the 2017-2018 National Health and Nutritional Examination Survey adult population age 19 and older (N = 5712) using the health belief model framework. An analysis of variance (ANOVA) with regression showed income was not a factor for nutritional awareness or uptake of plant-based compliant foods. Using an ANCOVA, there was a mean difference for males in uptake of plant-based compliant nutrition and awareness of MyPlate. There was a mean difference among race and education level for awareness. The application to professional practice may provide positive social change through public health awareness programs and policy on nutritional awareness to increase health literacy and reduce chronic disease rates among lower socioeconomic populations in the United States.

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Dedication

In loving memory of my parents Richard and Vernice Frazier, I dedicate the completion of this study. I will never forget how proud my father was to share that his daughter would one day be a doctor. I dedicate this work to my beloved husband Troy and five sons (Sebastian, Slade, Tristen, Ty, and Zayin) who have been a blessing in my journey to discover my call to social change. They stood alongside me during every season of my journey and supported me through each stage. Lastly, I recognize my two special lifelong friends whom I have cherished as beloved sisters Kim and Margaret. May our souls never be divided. Lastly, my life changed forever when I moved from Tennessee to Nebraska where I reconnected with my extended sisters Megan and Mica whom both warmly accepted me and have taught me to stand strong and face my fears.

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I want to acknowledge my Lord and Savior, Jesus Christ, as the only reason I could see my study complete. With His strength, I persevered through to the finish line of this study. I am so grateful to Walden University for providing a platform for a busy mother to complete her dream of achieving her doctorate. Dawn, my academic advisor, tirelessly searched to answer my questions and create a flow to keep me moving forward. I want to thank Dr. Kumar and Dr. Francavillo, who were instrumental in their instructions to excellence and kind words of encouragement. I will forever be grateful.

One only becomes the average of their few closest friends, so it is with great honor that I acknowledge my friends Rachel, Kelley, Renae, and Lisa, who have stood by me during the most challenging times of this study and my life and who encouraged me to know my worth and fight the good fight! They stand as a true testament to how well Luigi's therapy works!

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Section 1: Foundation of the Study and Literature Review

Uptake of Plant-Based Nutrition and Awareness among Lower Socioeconomic Status Populations in the United States

Chronic disease accounts for 86% of the annual health care expenditures in the United States, with heart disease listed as the leading cause of mortality followed by cancer, stroke, and diabetes (Centers for Disease Control and Prevention, 2017). The annual health care cost in the United States is \$3.8 trillion according to the CDC (2021). A principal factor associated with diabetes is the obesity rate in the United States. Prevalence for obesity 2017-2018 was 42.4 % (CDC, 2020). The CDC (2020) reported that the 2008 medical costs associated with obesity were \$147 billion. With the rise of health expenditures in the United States and the burgeoning research in nutrition, it may be best to investigate the effectiveness of a whole food plant-based (WFPB) diet as an effective means to address the increasing rate of chronic disease among lower socioeconomic status (LSES).

Ostfeld (2017) defined WFPB nutrition as a diet consisting of fruits, vegetables, whole grains, legumes, leafy greens, nuts, seeds, herbs, spices, and proteins that minimize or excludes all animal products, including dairy (i.e., red meat, poultry, fish, milk, eggs, and cheese). A plant-based diet excludes all processed products to include processed sodium, fat, and refined sugars. The term “whole,” first introduced by Campbell (1998), referenced WFPB nutrition as the complete omission of all processed foods, and minimizing animal-based proteins (Center for Nutritional Studies, 2018). The central idea behind a WFPB diet is consuming fresh foods in their most natural state instead of

processed items that have added ingredients or preservatives (Center for Nutritional Studies, 2018). A plant-based diet may supply a cost-effective reduction in chronic disease and dependence on pharmaceuticals which is critical among vulnerable populations (Ware, 2014). The costs associated with treatment methods should be a consideration for addressing nutrition among LSES. Tuso et al. (2013) said that plant-based nutrition (PBN) is the most cost-effective and low-risk intervention for lowering conventional biomarkers (i.e., body mass index, cholesterol levels, and blood pressure). Public health platforms should include nutritional interventions that are cost-effective and adaptable to reduce the risk and rate of chronic disease among the vulnerable populace. The rate of chronic health conditions among those consuming animal proteins compared to WFPB dieters is significantly higher (Morton et al., 2014). Trapp and Levin (2012) supported using a WFPB diet to efficiently treat cardiovascular disease (CVD), type 2 diabetes, and obesity. Kerley (2018) added that PBN reverses the severity of heart disease among patients. Furthermore, Esselstyn (2017) found a significant reduction in CVD among a patient study and suggested that PBN could prevent and reverse cardiovascular disease, while Campbell (2017) acknowledged that nutrition could influence some cancers. The current studies that provide evidence to support an association between chronic disease and nutrition are foundational to investigating the perceptions of uptake of PBN among LSES.

Problem Statement

Lower socioeconomic status (LSES) groups are particularly susceptible to poor nutrition, which increases the likelihood of chronic illnesses (French et al., 2019). LSES

may be considered a vulnerable population which requires public health initiatives to promote nutritional education, as the standard American Nutritional Guidelines (Office of Disease Prevention and Health Promotion, 2020). The guidelines' primary purpose is to equip policymakers and health professionals for implementing public health nutrition education (ODPHP, 2020). French et al. (2019) claimed lower-income groups purchased less nutritional food items when compared to higher-income groups. However, those within the low-income group were primarily female, were more likely to be obese, had larger household size, were primarily African American, were not married, were less educated, received supplement nutritional assistance (SNAP), and were not employed full time (French et al., 2019). Trends in health care education are changing dietary literacy among health professionals, but there may be barriers between health care provider knowledge and the dissemination of nutritional knowledge to patients. Barriers to nutritional knowledge for patients during routine physical exams mean a greater need for public health initiatives and policies to promote nutrition among vulnerable groups. Lee et al. (2015) reported that 89% of the participants in their study had no prior knowledge of a whole food plant-based (WFPB) diet for treatment of type 2 diabetes, even though 72% of the health care providers serving them knew the effectiveness of a WFPB diet in reversing the disorder. Lee et al. reported that the barrier for medical professionals in disseminating PBN to patients was the belief that patients would not adhere to a WFPB diet. Policies should be in place to promote nutrition education if physicians do not provide patients with the knowledge of nutrition (Storz, 2019) claimed that the lack of nutritional education among health care providers might be a barrier to patient health

literacy. Lee et al. found that 66% of the patients with PBN education were willing to try the diet citing that patient barriers included perceived dietary choice and lack of education on meal planning. Terzic and Waldman (2011) admitted that the United Nations recognizes the need for prevention methods in chronic disease outcomes by reducing saturated fats, trans-fats, salt, and refined sugars, notably in processed foods. The Standard American Nutritional Guidelines (ODPHP, 2020) support reducing saturated fats, sodium, and sugar-sweetened beverages. Esselstyn (2017) suggested that current methods of the American Nutritional Guidelines have not effectively reduced rates of CVD, suggesting that amendments in 2010 nutritional guidelines may help change perceptions and behaviors toward PBN for better health outcomes. A 2010 report from ODPHP (2020) showed a 57.8% adherence to the nutritional guideline among Americans aged 2 and older.

Additional research is required to understand how awareness of PBN could affect uptake among susceptible populations in the LSES (Allès et al., 2017). The research data on individuals eating vegan and vegetarian diets are minimal and may consist of confounders such as dietary intake of processed foods which might skew the results for studies focusing on WFPB outcomes (Clarys et al., 2014). Processed foods may be considered compliant in both vegan and vegetarian diets. However, foods that are processed and refined are non-compliant with a WFPB eating style. One focus of the nutritional guideline is to create better eating patterns due to the perception that eating patterns may be a better predictor of health status and disease risk (ODPHP, 2020). Although current public health nutritional initiatives support the addition of fruits and

vegetables to reduce red meat and processed foods, the guidelines may not highlight a clean, nutritionally dense diet of whole foods (Terzic & Waldman, 2011). With low adherence rates to the guidelines, it may be beneficial to look at nutritional perceptions outlined in the HBM. Precise representations of nutritional choices are essential among vulnerable populations. The dietary guideline is a collaborative effort between the U.S. Department of Agriculture and Health and Human Services, updated every 5 years and provides insight to low-income groups and diet but does not consider compliance of a plant protein diet (United States Department of Agriculture, n.d.).

The initial design of MyPlate was to be an easy-to-understand visual to counteract low nutritional literacy rates for meal preparers in the home (USDA, n.d.). MyPlate nutritional guidelines focus heavily on promoting fresh fruits and vegetables as well as other whole foods that are compliant to WFPB dietary choice. Some barriers to eating WFPB among LSES groups are perceived access to plant-based compliant foods, dietary perceptions, and low health literacy (Pescud & Pettigrew, 2014). A lack of nutritional literacy among vulnerable groups may increase the likelihood of nutritional-related chronic disease (Pescud & Pettigrew, 2014). Application of awareness among the priority populace encouraging PBN may have the potential to reduce noncommunicable disease (NCD) rates and encourage better nutritional choices. In addition, limited data on vegan and vegetarian behaviors in nutrition with attention to processed food intake results in a need for further studies (Clarys et al., 2014). There is a gap in the literature on the effectiveness of awareness of a plant-based diet among LSES and how awareness affects

the uptake of PBN compliancy or whole food intake without confounding variables such as non-compliant food choices in the American diet.

Purpose of the Study

The purpose of this quantitative study is to compare plant-based nutritional uptake and awareness among groups by income with covariates gender, education, and race. This study observed any differences between socioeconomic conditions and uptake or adherence to plant-based nutrition through awareness of MyPlate or Googled for information with covariables gender, education, and race. The population sample is from the 2017-18 National Health and Nutritional Examination Survey (NHANES) dataset of American adults. The theoretical framework for this study is the health belief model (HBM), which posits behavioral changes occur based on individual perceptions.

Research Questions

RQ1: Is there a difference between lower-income groups and higher income groups measured for the uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet?

H_{01} : There is no difference between lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

H_{11} : There is a difference between lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness

of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

RQ2: Is there a mean difference between gender count (Male and Female) among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet?

H_02 : There is no mean difference between gender count (Male and Female) among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

H_12 : There is a mean difference between gender count (Male and Female) among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

RQ3: Is there a difference between education level among lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet?

H_03 : There is no difference between education level among lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

*H*₁₃: There is a difference between education level among lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

RQ 4: Is there a difference between race among lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet?

*H*₀₄: There is no difference between race among lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

*H*₁₄: There is a difference between race among lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

Theoretical Foundation for the Study

The health belief model (HBM) posits individual willingness to change is from four perception constructs (Rosenstock, 1966). The HBM in figure 1 is the best framework for this study in understanding the perceptions of uptake of plant-based nutrition (PBN) and awareness among lower LSES groups. The framework provides a lens for perceived severity and susceptibility to chronic diseases among the target

population. Additionally, the model outlines the perceived benefits for action and perceived barriers associated with diet and nutritional awareness. If individual perception is the capability for change above the barriers and value of the benefits, the result is efficacy for the uptake of nutritional selection. The HBM is instrumental in developing programs for health and nutrition, emphasizing perceived barriers and willingness toward a plant-based diet (Corrin & Papadopoulos, 2017). The constructs of the HBM in figure 2 influence the independent variable awareness. Interventions which include self-efficacy components in health education settings may be more effective in behavior change targeting perceived susceptibility, perceived severity, perceived benefits, and perceived barriers. These constructs can be predictive for further action to cues of action and self-efficacy.

Figure 1

Health Belief Model

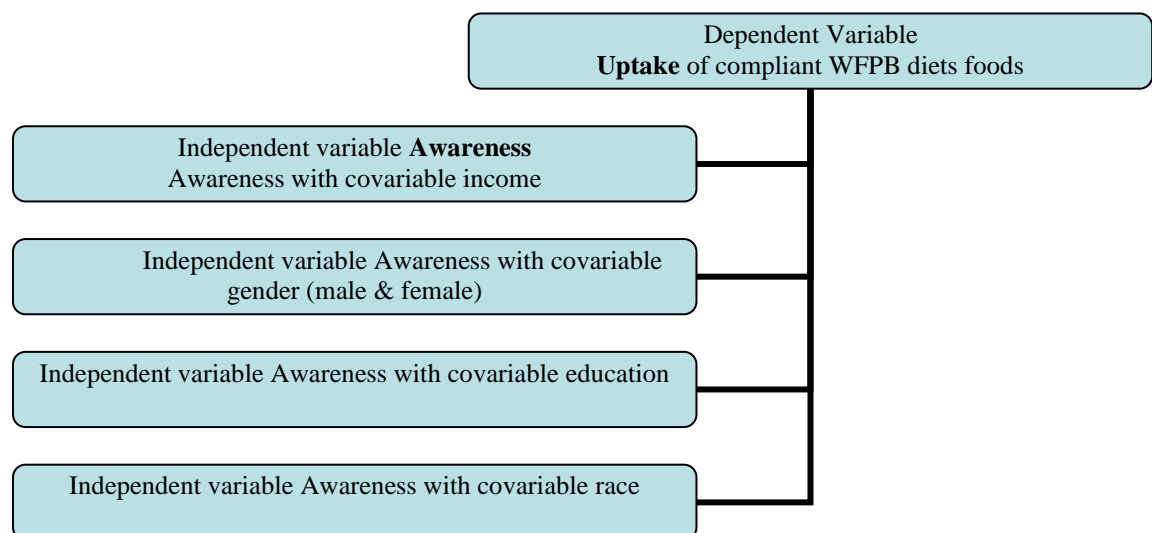
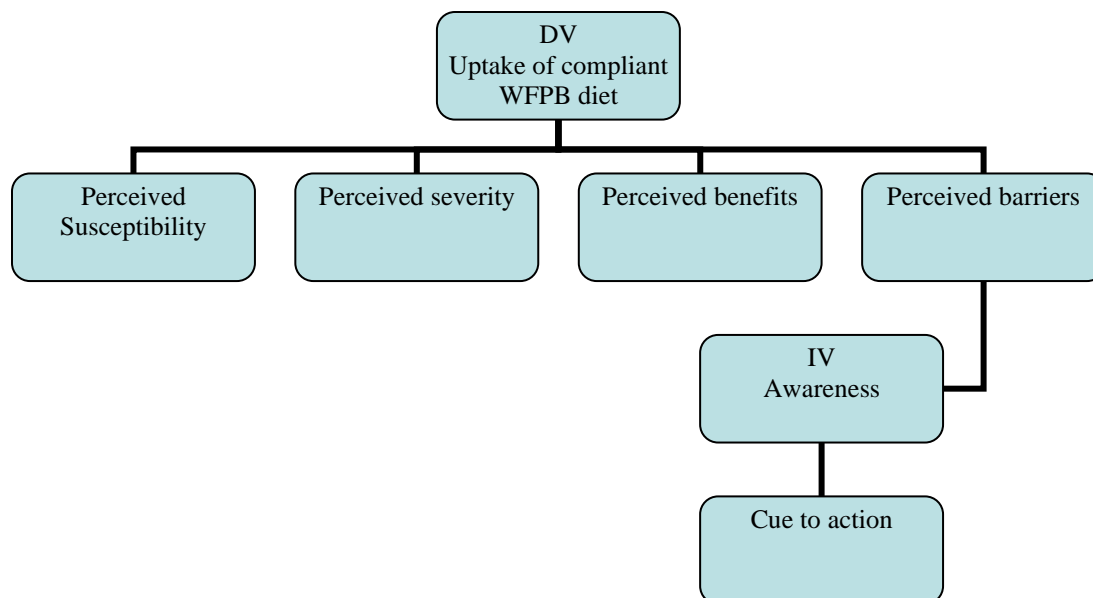


Figure 2*Dependent and Independent Variables***Nature of Study**

The nature of this quantitative retrospective study was to examine the uptake of a WFPB diet among vulnerable populations to examine the impact of PBN awareness among LSES groups considering education level, race, and income variables. A quantitative approach is best for observing associations between the uptake of PBN compliance and awareness of nutritional education through MyPlate or Googled for information about the nutritional guidelines of MyPlate. The covariates are income, gender, education, and race. I will use SPSS to analyze adults aged ≥ 19 years through 79 in the United States from the 2017-18 NHANES data set. NHANES serves as a sample of national representation of the United States population. The National Center for Health Statistics of the Centers for Disease Control and Prevention initially collected the data.

Literature Search Strategy

I searched for relevant literature from the Walden University Library, Thoreau, Mendeley, and Google Scholar databases. The search was limited to peer-reviewed scholarly journals using the search terms, keywords, and phrases listed below with results. Next, I narrowed the search of articles published since 2015 using the same search terms across the same database. Additionally, I received alerts from Mendeley for articles on plant-based nutrition using the phrase “plant-based nutrition.” I had assistance from my chair and Walden University librarian support for a few articles related to HBM.

Keywords and phrases were limited to 2015: Plant-based nutrition (191 results), nutrition “and” health (nine results), a vegan diet limited to 2019 (315 results). I also searched plant-based diet and cardiovascular disease (42 results), Esselstyn (17 results), Plant-based diet “and” Low income (16 results), nutrition “and” lower socioeconomic status (14 results), Plant-based diet “and” barriers (11 results), Plant-based diet “and” diabetes (95 results), whole food AND National Health and Nutrition Examination Surveys (NHANES) with only (three results). I also search the terms: kidney function “and” animal protein (eight results), Cancer “and” nutrition “and” vegan (4 results), low nutrition “and” low income (990 results), nutrition quality “and” income (20 results), American nutritional guidelines (18 results). I searched the terms with the limiter of peer review: MyPyramid (1151 results) and after limiting for 2015 (119 results).

Definition of Whole Food Plant-Based Nutrition

The main component of whole food plant-based nutrition (WFPBN) is the natural state of the foods in the whole form (Center for Nutritional Studies [CNS], 2018). Foods included in plant-based nutrition (PBN) are fruits, vegetables, and whole grains in their natural form without additives or processing (Ostfeld, 2017). The instrumental component of the WFPBN diet is the removal of processing and animal products (CNS, 2018). Campbell (1998) first introduced the term "whole" as the complete omission of all processed foods and removing animal-based proteins from the diet (CNS, 2018). Both vegan and vegetarian diets may include processed foods non-compliant to WFPBN (Allès et al., 2017). The limited data on plant-based nutritional studies is partly due to recent studies targeting vegan and vegetarian groups without consuming processed foods (Allès et al., 2017). These confounders influence the outcomes when using vegan or vegetarian datasets to study the plant-based diet. Berryman et al. (2016) confirmed that further research concerning protein sources is needed to determine effects on cardiometabolic disease. The variables for protein sources from the Berryman et al. (2016) study on the association between protein and kidney function included animal, dairy, and plant protein. The identified plant protein for Berryman et al.'s study was yeast bread and rolls, not whole foods such as those identified by the CNS (2018). Defining whole food is a central consideration for selecting the variables to measure in this study.

Effectiveness of Plant-Based Nutrition in Noncommunicable Disease Outcomes

According to the CDC (2017), chronic disease in the United States accounts for 86% of the annual health care expenditures. Many conditions (i.e., heart disease, cancer,

diabetes, and obesity) are associated with nutrition (Office of Disease Prevention and Health Promotion [ODPHP], 2020; World Health Organization, 2019). The evidence supporting the effectiveness of PBN to reverse the severity of heart disease is critical to the argument that the analysis of nutrition among vulnerable populations is needed (Kerley, 2018).

Impact of Plant Base Nutrition on Cardiovascular Disease

There is a growing body of evidence to support the nutritional benefits of a healthy diet of fruits and vegetables in fighting cardiovascular disease. According to the CDC (2020), heart disease is the number one cause of mortality in the United States, followed by cancer and diabetes. Although current nutritional guidelines provide education on adopting more fruits and vegetables in a healthy diet, it may not effectively influence healthier food choices (Esselstyn, 2017). Plant-based nutrition omits animal-based protein, dairy, and processed foods from the diet (Ostfeld, 2017). There is encouraging evidence to show that a plant-based diet can effectively treat chronic conditions such as cardiovascular disease (CVD). Esselstyn (2017) emphasized that whole food plant-based nutrition can both prevent and reverse CVD and that current dietary suggestions within the United States guidelines, as well as current allopathic treatments, are ineffective. Patients who adhere to a plant-based diet can experience a reversal of cardiovascular damage (Esselstyn, 2017). Patients in a control group for WFPBN who returned to the animal protein diet saw decreased endothelial function (Esselstyn, 2017). CVD is the leading cause of death in the United States but is a preventable disease through behavioral and lifestyle choices, especially concerning diet

(CDC, 2017). Heart disease and cancer are leading causes of death in the United States, respectively (CDC, 2017).

Cancer and Nutrition

Cancer is the second leading cause of death in the United States (CDC, 2017). The ODPHP (2020) listed both colorectal and postmenopausal breast cancers as nutritionally related. Campbell (2017) reported increased cancer risk among those eating animal-based protein from human population studies. More research may provide a better understanding of how nutrition is associated with cancer.

Impact of Plant-Based Nutrition on Type 2 Diabetes

Nutrition is a significant component of the prevention, management, and even treatment of type 2 diabetes (T2D), according to the American Diabetes Association (2020). Although nutrition effectively manages blood glucose levels in patients with T2D, current studies show that PBN may reverse the disease. Lee et al. (2015) reported that T2D is lower among groups who have adopted plant-based nutrition and that a plant-based eating style lowers HbA1c levels more than any of the dietary recommendations of the American Diabetes Association.

Knowledge is essential for positive health behaviors in the public health setting. In a study with a group of patients diagnosed with T2D, 89% of the participants had no prior knowledge of a plant-based diet as a treatment option, although 72% of the health care providers serving them knew the effectiveness of plant-based nutrition in reversing T2D (Lee et al., 2015). Once patients were made aware of the benefits of PBN, they were willing to make changes to their eating patterns. Lee et al. found that 66% of patients who

were provided education on PBN were willing to try the diet, indicating patient barriers were perceived dietary choice and lack of meal planning education.

The Vulnerability of Lower Income Groups

Lower socioeconomic (LSES) groups are particularly susceptible to chronic illnesses associated with poor nutrition (French et al., 2019). Vulnerable populations benefit from strategic public health initiatives which promote nutritional education. Trends in health care education are changing dietary literacy among health professionals, but there may be barriers between health care provider knowledge and the dissemination of nutritional knowledge to patients. Potentially, false perceptions of health care providers of patients' noncompliance with a WFPB diet will decrease the likelihood that physicians will provide nutritional education to their patients (Lee et al., 2015). Although nutritional education is made more available to health care professionals, there are still challenges issuing nutritional education to patients. Storz (2019) contrasted the argument that the lack of nutritional education among health care providers might be a barrier to patient health literacy regarding PBN. In which case, an upstream approach may prove more effective in educating the public and improving nutritional patterns. Terzic and Waldman (2011) stated the United Nations recognizes the need for prevention methods in chronic disease outcomes by reducing saturated fats, trans-fats, salt, and refined sugars, notably in processed foods. Likewise, the Standard American Nutritional Guidelines support reducing saturated fats, sodium, and sugar-sweetened beverages and recommend adding fruits and vegetables (ODPHP, 2020). Current methods of the American Nutritional Guidelines have not effectively reduced rates of CVD, suggesting

amendments in 2010 nutritional guidelines may help change perceptions and behaviors toward PBN for better health outcomes among vulnerable populations (Esselstyn, 2017).

Additional research is required to understand how awareness of PBN could affect vulnerable populations in the LSES (Allès et al., 2017). The research data on individuals eating vegan and vegetarian diets are minimal and may consist of confounders such as dietary intake of processed foods which might skew the results for studies focusing on WFPB outcomes (Clarys et al., 2014). The nutrition term itself is new to the American culture. Processed foods may be considered compliant in both vegan and vegetarian diets. However, processed and refined foods are non-compliant with a WFPB eating style (CNS, 2018).

Eating Patterns for Lower Socioeconomic Status Groups in the United States

Culturally diverse eating patterns within the United States influence dietary perceptions and selection. Observing eating patterns may provide better insight into health than calculating nutrients or caloric intake (ODPHP, 2020). Some barriers to evaluating food patterns among vulnerable groups are cultural, agricultural, health literacy rates, and economic. Public health nutritional initiatives often target the barriers. However, adherence to the recommended nutritional guidelines is a barrier among lower-income groups (Holston et al., 2020). Holston et al. focused their qualitative study on rural low-income individuals from a specific food insecure region of the southern United States. Although culture can be a component of food choice, a common theme is food insecurity creating a need for innovative supplementation.

Food Supplementation Through Food Pantries and Service-Oriented Organizations

Lower-income groups have resources through charitable donations that supplement nutrition. Examples of social service organizations which target low-income groups within their respective communities are food pantries. It is common to find processed foods because they have a longer shelf life and are easy for community members to donate. It is also common knowledge that many processed foods have sugar additives. High sodium content in canned foods creates concern as well.

Nutritional Education Dissemination Among Health Care Practitioners

Vulnerable populations who access medical care will benefit from the educational resources available during visits. Consequently, it is imperative to address barriers in nutritional education within the health care setting. Health providers are the intermediary for patient education. Health care professionals should advance health literacy when patients attend routine medical office visits or emergency room services. Nutrition is an instrumental component to many chronic conditions seen during office visits and should include patient education. Although health care providers may have increased their awareness of nutritional education and the benefits of a plant-based diet, disseminating this knowledge to their patients is critical during those routine visits. However, perceptions of health care providers may be a barrier to patient education in which physicians may perceive their patients will not adhere to a specialized diet and therefore eliminate nutritional education during time sensitive visits.

Terzic and Waldman (2011) stated public health nutritional initiatives support the addition of fruits and vegetables and reduce red meat and processed foods but do not

promote nutrient-dense whole foods which consider low health literacy rates. There is a disconnect between the uptake of compliant foods and the eating patterns among American adults (ODPHP, 2020). The Food Pyramid nutritional guideline in the United States, renamed MyPlate, was designed to be a more comprehensive visual tool to improve low nutrition literacy among meal preparers in the home (USDA, n.d.). Some of the barriers to eating whole food plant-based (WFPB) among lower socioeconomic status (LSES) groups are perceived access to plant-based compliant foods, dietary perceptions, and low health literacy (Pescud & Pettigrew, 2014). Low nutritional literacy among LSES groups increases the likelihood of nutritionally related chronic disease (Pescud & Pettigrew, 2014). Application of awareness among LSES encouraging PBN may have the potential to reduce noncommunicable disease (NCD) rates in the United States and encourage better nutritional choices among vulnerable populations.

The ability to disseminate educational information on a public health level is crucial for addressing barriers to LSES. In addition, the limited data on vegan and vegetarian behaviors and perceptions in nutrition is minimal, resulting in a need for further studies among the LSES adopting a plant-based diet. Therefore, the effective behavioral outcomes among LSES from the MyPlate guidelines indicate the necessity for more research in plant-based nutrition as a preventative measure.

Historical Review of the United States Nutrition Guidelines

The nutritional guidelines developed for the United States were to ensure public health leaders and other professionals make decisions to encourage nutritional literacy (USDA, 2020). The guidelines serve as recommendations for the public through the

initiatives and programs. The design of MyPyramid and MyPlate were representations from the nutritional guidelines for public health nutritional education. MyPyramid preceded MyPlate, but each has specific differences which allow users to understand healthy eating briefly. The NHANES data represent include questions regarding knowledge of both MyPyramid and MyPlate. Schwartz et al. (2019) used multivariate regression to analyze 2011-2014 NHANES data for a relationship between MyPyramid and MyPlate adjusting for socioeconomic factors and found that exposure to MyPlate was associated with healthier intake. Schwartz et al. reported that further research is necessary to understand the barriers and intake for MyPlate users.

The nutritional guideline in the United States is a public service announcement to promote healthy food selection with a focus to increase fruit and vegetable intake which are compliant to plant-based culture. Technology and social media influences have provided more accessible access to nutritional and health knowledge. The NHANES data include the variable “looked up MyPlate on the internet” represents the self-efficacy levels of the participants. The components of the guideline are to ensure that all necessary nutrients are part of the daily diet based on the average child or adult dietary needs. However, there is a deficiency in the uptake of compliant food selection in America, especially for fruit and vegetables. Only one in ten adults in the United States consume the recommended daily intake of fruits and vegetables and socioeconomic attributes influence the outcomes (Lee et al., 2022). The consumption of highly processed foods is high among Americans although current public health programs promote fruit and vegetable intake. Processed foods are low in nutritional density and much higher in

caloric count. Low-income populations have the propensity to consume fewer fresh fruits and vegetables (French et al., 2019). There is a need to investigate how to reduce the consumption of highly processed foods among LSES.

Barriers for Uptake of Plant-Based Nutrition

The barriers to uptake of a plant-based diet among lower socioeconomic groups include perceived costs, knowledge of compliant dietary or meal preparation, and knowledge of the diet (Pescud & Pettigrew, 2014). It is essential to reduce barriers concerning nutrition among vulnerable populations due to the importance of nutrition to good health. Perceptions of cost are essential when determining initiatives that recommend positive behaviors for successful outcomes. Understanding the compliancy of nutrition is an instrumental component of a healthy diet. Policies and initiatives influence the knowledge of meal preparation among the target population.

Cultural Eating Patterns Among Lower Socioeconomic Status

In the United States, food selection and dietary habits are considered cultural for many groups. A review of the cultural eating patterns in the United States provides an understanding among groups in the lower income and education level. Additionally, gender and race may indicate specific eating patterns which may be valuable in assessing nutritional selection habits among LSES status. Cultural eating patterns differ when considering the person who prepares meals for the family, and differences apply to whether the meal preparer is male or female across diverse cultural environments. McKenzie et al. (2022) noted gender inequalities and the importance of culture regarding nutrition. The role of nutrition regarding race should factor in cultural differences and the

perceptions that contribute to outcomes. Parcha et al. (2020) reported differences by race using the NHANES data to show hypertension rates higher among non-Hispanic Black followed by non-Hispanic White young adults.

Conclusion

By definition, a plant-based protein diet is the omission of all processed foods and animal products. Evidence based practice and research studies support the effectiveness of plant-based nutrition on combating and reducing noncommunicable disease and yet policy and initiatives place more emphasis on downstream efforts. Vulnerable groups are more susceptible to conditions with nutritional correlation. Often Lower socioeconomic groups supplement their food sources through local food pantries and faith-based organizations which may provide products with less nutritional density and freshness. Access to healthy food for lower income groups is not the only association to poor health outcomes. Often the barriers to healthier eating include perceptions of diet. Cultural beliefs and norms are instrumental in the development of perceived dietary choices.

Definitions

Whole food plant-based (WFPB) represents a diet consisting of no animal products, including eggs, milk, cheese, and animal protein. Additionally, it excludes all processed foods. The terms Plant-based nutrition and WFPB are interchangeable. The vulnerable population for this study represents the lower-income status.

Assumptions

The assumptions associated with this study are that each participant answered the questions honestly and without hesitation of negative recompense or expectation of compensation and a minimal sample is available.

Scope and Delimitations

The scope and limitations of this study are limited to adults aged 19 and older in the United States. Delimitations include location or the demographics of participants, missing answers to the survey questions, and no way to trace the consumption of non-compliant foods such as processed foods. Delimitations regarding the HBM include the social factors. The MyPlate design for public nutritional awareness and is limited in the ability of promoting compliance to plant-based eating exclusively although the design is intended to encourage higher intake of compliant foods.

Significance Summary Conclusion

Observation of the behavior change likelihood among a vulnerable population with exposure to whole food awareness through MyPyramid or if respondents looked up MyPlate on the internet may have the potential to alter the outcomes for personal decision making in food selection toward healthier whole food plant-based choices. Uptake of better nutrition is particularly beneficial among LSES. The social significance of understanding behavioral changes among the LSES may result in information to influence changes to the current nutritional guides and other initiatives which support nutritional health literacy in the United States. Changes in policy and initiatives also may reduce chronic diseases which affect healthcare expenditures. Observation of the

dependent variable uptake of PBN foods among income groups and the independent predictor variable of awareness through MyPlate or if respondents looked up MyPlate on the internet using covariables (income, sex, education, and race) may provide insight for public health initiatives which result in a positive behavioral change for priority populace. Analysis of the data may offer further research into policy and recommendations for nutritional education targeting vulnerable populations. The USDA (2020) nutritional recommendations affect nutritional choices in public schools, hospitals, and the penal system. Additionally, social service organizations (i.e., food banks and pantries) which supplement nutritional resources to the target population in the lower-income groups may better understand their populations' needs and result in better health outcomes among vulnerable groups.

This study can impact the broader community by observing behavioral changes among vulnerable groups in healthy food selection choices after exposure to PBN awareness to reduce chronic disease rates. The social change implications of changing behaviors among LSES groups might reduce noncommunicable diseases associated with nutrition, such as CDV, type 2 diabetes, and obesity. Highlighting fresh whole foods through public health awareness may change behaviors and reduce barriers toward healthier choices among lower SES groups. By looking at the uptake of plant-based nutrition among LSES, where the focus is on whole fresh plant-based proteins, public health initiatives can encourage desired behavioral changes among a very vulnerable population. The original contribution of this study will provide insight into the behaviors of uptake in nutritional choice for a population considered high-risk for many chronic

diseases associated with nutrition and education for a policy which influences healthy eating patterns across multiple settings for better public health outcomes.

Section 2: Research Design and Data Collection

Introduction

Chronic disease accounts for 86% of the annual healthcare expenditures in the United States, and nutrition plays a vital role in health (CDC, 2017). When developing educational programs among at-risk populations, the correlation between health outcomes and nutrition is essential. LSES groups in the United States are particularly vulnerable to the effects of chronic disease and nutrition and stand to benefit the most from nutritional education programs. The HBM (Rosenstock, 1966) is the theoretical framework for this study and posits that willingness to change dietary intake on an individual level is perceived susceptibility, perceived severity, perceived benefits, and perceived barriers. The HBM expands on the notion that a cue to action is necessary to prompt positive behavioral change. The purpose of this quantitative study, with a retrospective cross-sectional design, is to compare the uptake of plant-based compliant nutrition with awareness of MyPlate nutritional guidelines with sociodemographic variables income, education, gender, and race by using an analysis of variance (ANOVA) and analysis of covariate (ANCOVA).

Research Design and Rationale

This study observed for any differences between socioeconomic conditions and the dependent variable uptake or adherence to plant-based nutrition guidelines based on the independent variable awareness of MyPlate for nutritional guidance with covariables gender, education, and race. Although the design did not provide causation for this study, it does provide the best view for addressing improvements in nutritional education among

vulnerable populations. Quantitative studies are best for observing a phenomenon that affects individuals and are less objective than qualitative studies regarding nutritional perceptions. Chronic disease in the United States accounts for 86% of the annual healthcare expenditures. The best representation of eating habits among Americans is data collected from the National Nutritional Surveys. The population sample for this study, the 2017-18 NHANES data set, is a longitudinal study on American eating habits and is a strong representation of the American diet.

Methodology

The research design is an ANOVA for Research Question 1 and ANCOVA for Research Questions 2-4, using SPSS to analyze for any differences between uptake and awareness among income levels using covariables gender, education, and race. An ANCOVA is the best choice for this study because it determines how two or more variables are related to a particular group. Manipulation of the variables was not required. Although an ANCOVA does not provide causation for this study, it provides the best observation for addressing improvements in nutritional education among vulnerable populations. Barzegari et al. (2011) used an ANOVA look at nutritional knowledge, attitude, and habits.

The instrumentation of constructs for this study were survey questions in a Likert scale design, personal interviews with questioning, and medical examination by professional staff (CDC, 2020). I analyzed the data for differences between groups based on income levels and uptake of plant-based nutrition through awareness of nutrition from

the standard American nutritional guidelines which support public health initiatives to increase proper eating habits.

This study is a quantitative study using the 2017-18 NHANES data set from the National Center for Health Statistics (NCHS). The probability sampling strategy is random. NHANES surveys represent the U.S. population because the sample design is completed in four stages (i.e., by county, census blocks, dwelling units, and individuals within households) among all U.S. counties (CDC, 2020). The method for this study is a quantitative research design using an ANOVA to analyze any differences between uptake and awareness among income levels and an ANCOVA to analyze for covariables gender, education, and race. The best statistical analysis to test the hypotheses is an ANOVA for quantitative research methods because it tests for differences between two or more means/groups by analyzing comparisons of variance estimates. Manipulating variables was not necessary. The weighting of this data provides a representation of the civilian noninstitutionalized U.S. population from every county providing a sample which is indicative of the U.S. population. The population size N=9254 respondents include all subjects. The population sample was calculated using a sample calculation G Power Statistical Power Analyses for Mac and Windows (Faul et al., 2007).

SPSS software package version [28.0] was used for analysis. I used the ANOVA test to analyze the data for differences between groups (i.e., income, gender, education, and race) and the uptake of plant-based selections from perceived awareness of nutrition of the standard American nutritional guidelines MyPlate or respondents' efficacy in Googling for nutritional information on the guidelines. Income variables are listed in

categories. Respectively, gender is defined as male $n=4557$ and female $n=4697$ and has no order of dominance and no missing variables. From the demographic measures, the race variable represented as “Mexican American,” “other Hispanic,” “non-Hispanic White,” “non-Hispanic Black,” “non-Hispanic Asian,” and “other including multi-racial.” Education level for adults aged 19-79 years is coded as “Less than 9th grade,” “9-11th grade (Includes 12th grade with no diploma),” “High school graduate/GED or equivalent,” “Some college or AA degree,” “College graduate or above,” “Refused, Don't Know,” and “Missing.”

The dependent variable of uptake for compliant nutrition and food choices is measured using the questionnaire data subcategory diet behavior and nutrition variables, “you drink soy milk,” and “another type of milk.”

The independent variable of awareness is measured using the questionnaire data subcategory diet behavior and nutrition variables “heard of MyPlate,” “looked up MyPlate on the internet,” “tried the MyPlate plan,” and “How healthy is the diet.”

Population

The population size for this study is $N=9254$ respondents from the survey, which includes all subjects. Gender variables are male $n=4557$ and female $n=4697$ with no order of dominance and no missing variables. The population sample of 128 was calculated using a sample calculation G Power Statistical Power Analyses for Mac and Windows (Faul et al., 2007). From the demographic measures, Race variables include Mexican American, Other Hispanic, non-Hispanic White, non-Hispanic Black, non-Hispanic Asian, and others, including multi-racial. Education for adults aged 19 – 79 years is

coded by education level. The dependent variable of uptake for compliant nutrition and food choices was measured using diet behavior and nutritional variables, other types of milk, soy milk, and how healthy the diet is. Questionnaire data for diet behavior and nutrition is the measurement for the independent variable of awareness of heard of MyPlate, looked up MyPlate on the internet, and tried the MyPlate plan.

The data are available on the Center for Disease Control and Prevention website and are available to the public for free.

Application to Social Change

This study's application to professional practice is that the results may provide knowledge for social change through public health education and policy that focus on targeted nutritional awareness for vulnerable populations. This study's application to professional practice may provide social change through public health awareness programs and policy which focuses on nutritional awareness of plant-based compliant foods to increase nutritional health literacy and reduce chronic disease rates among a vulnerable populace in the United States. The social change implications of changing behaviors among LSES groups might reduce noncommunicable diseases associated with nutrition, such as CDV, type 2 diabetes, and obesity. Highlighting nutritious foods supported by evidence for positive health outcomes through public health awareness initiatives and policy may influence behaviors and reduce barriers toward healthier choices among lower SES groups. By looking at the uptake of plant-based nutrition among LSES, where the focus is on whole fresh plant-based proteins, public health initiatives can encourage desired behavioral changes among a very vulnerable population

which will significantly affects NCD in the United States, where a substantial majority of the population consume highly processed diets. The original contribution of this study will provide insight into the behaviors of uptake in nutritional choice for a population considered at-risk for many of the chronic diseases associated with nutrition which can heavily influence education and policies which provide an upstream approach to better public health outcomes.

The Instrumentation of constructs for this study is survey questions in a Likert scale design, personal interview questioning, and medical examination.

Research Questions and Hypotheses

I will examine differences between plant-based nutritional uptake and awareness of MyPlate guidelines among groups by income with socioeconomic demographics, gender, education, and race.

RQ1: Is there a difference between lower-income groups and higher income groups measured for the uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet?

H_{01} : There is no difference between lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

H_{11} : There is a difference between lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness

of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

RQ2: Is there a mean difference between gender count (Male and Female) among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet?

H_02 : There is no mean difference between gender count (Male and Female) among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

H_12 : There is a mean difference between gender count (Male and Female) among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

RQ3: Is there a difference between education level among lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet?

H_03 : There is no difference between education level among lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

*H*₁₃: There is a difference between education level among lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

RQ 4: Is there a difference between race among lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet?

*H*₀₄: There is no difference between race among lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

*H*₁₄: There is a difference between race among lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

Threats to Validity

Threats to validity include confounding factors such as the limited data for processed food usage among respondents. In addition, there may be differences between the time of data collection and current conditions regarding educational awareness toward plant protein advantages. The secondary data are from the Center for Disease Control and

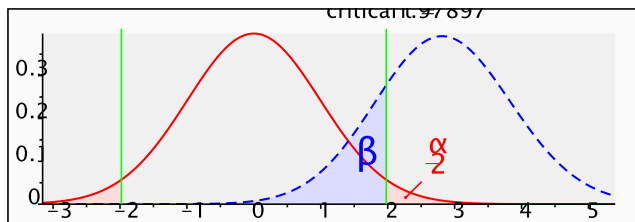
Prevention database. The NHANES are a public use data set that can be requested by application and accessed by permission.

Power Analysis

I used G Power Statistical Power Analyses for Mac and Windows (Faul et al., 2007) for quantitative studies for power calculation. I used an ANCOVA and ANCOVA to analyze the data for differences between groups (i.e., income, education, race, and gender) and the uptake of plant-based selections from perceived awareness of nutrition of the standard American nutritional guidelines MyPlate or respondent's efficacy in Googling for nutritional information on the guidelines. I used an ANOVA to observe any differences between socioeconomic conditions (income) and the dependent variable (uptake or adherence) to plant-based nutrition guidelines based on the independent variable (awareness of MyPlate for nutritional guidance). The power calculations for the first research question are for an ANOVA test with means difference between two independent groups, two tailed test with 0.5 medium effect size for practical significance, and an alpha level 0.8 results for a sample size of 128. A medium effect size indicates practical significance or meaningful differences between groups.

Figure 3

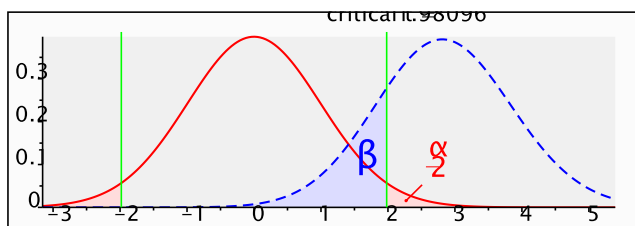
Power-Calculation G Power for Research Question 1



I observed for any differences between gender and the dependent variable (uptake) based on the independent variable (awareness) using an ANCOVA for the covariates gender, education, and race, respectively. I used G Power calculations for the research questions with covariates for an ANCOVA with means difference between two independent groups, two tailed test with medium effect size for practical significance, and an alpha level 0.8 results for sample size of 64 for each group. A medium effect size indicates a practical significance or meaningful differences between groups.

Figure 4

Power Calculation G Power for Research Questions 2,3,4



Ethical Procedures

The Secondary data are from the Center for Disease Control and Prevention database. The NHANES are public use data that can be requested by application and accessed by permission. The privacy of human participants is protected by non-identifying unique participation ID and personal identifiers such as names are not linked to the questionnaire answers or exam results. All participants are provided reassurance that answers are voluntary and confidential providing for ethical considerations. All data are password protected and encrypted. Participants are reassured that only appropriate personnel have access to view data and only regarding need. A privacy PDF is available for download explaining protection of public privacy. Current law regarding confidentiality and protection are listed in the PDF. The primary collector does not destroy data. However, the secondary dataset or sample is anonymous. Rather, typical characteristics such as demographics, gender, income, race, and food choice are included in the secondary data collection. Therefore, archival data will have no identifiable information or conflict of interest.

Summary

This quantitative study aimed to observe any differences between socioeconomic conditions and the independent variable awareness of nutrition and dependent variable uptake of plant-based nutrition. Covariates included gender, education, and race. The population sample is from the 2017-18 NHANES data set of American adults. The theoretical framework is the HBM which posits individual perception influences behavior

choices regarding nutrition and health. The research questions addressed differences between lower-income and higher-income groups measured for the uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of either MyPlate or if each respondent googled for information on MyPlate. Knowledge in nutritional uptake among vulnerable populations can better equip public health educators to reduce chronic disease rates among LSES.

Section 3: Presentation of the Results and Findings

Introduction of Results and Findings

This study is a quantitative study using the 2017-18 NHANES data set from the NCHS with random probability sampling. Permission to collect data was given by Walden University IRB approval number 04-11-22-0748983 to conduct analyses for this study. NHANES data and codebooks are available upon request and are free to the public to download for use. The population size is N=9254 respondents from the survey which includes all subjects. The minimum sample size of 128 and 64 respectively was calculated using a sample calculation G Power Statistical Power Analyses for Mac and Windows (Faul et al., 2007). I downloaded the demographic and diet and behavior questionnaire datasets from the NHANES website. Both files were in XPT extensions, a statistical software suite (SAS) developed by SAS Institute which is compatible with SPSS. I saved each dataset as SPSS files and merged the two NHANES datasets, demographic and diet and behavior questionnaire, using the response sequence number variable to align all information to correct responses. I filtered the merged dataset of N=9254 for age in years at screening to include only adults ages 19-79 which resulted in case sample size of n=5712 adult respondents. Age was topcoded in the original dataset at 79 to protect the identity of the limited number of respondents who fell into that age category.

This quantitative study examines any differences between plant-based nutritional uptake and awareness of MyPlate guidelines among groups by income with covariables gender, education, and race. The first research question is there a difference between

lower-income groups and higher income groups measured for the dependent variable uptake of plant-based compliant nutrition with the independent variable awareness of nutrition by knowledge of the MyPlate (whether respondents heard of or tried MyPlate) or if respondents looked up MyPlate on the internet is analyzed using an ANOVA to observe any differences between socioeconomic conditions income and the dependent variable uptake or adherence to plant-based nutrition guidelines based on the independent variable awareness of MyPlate for nutritional guidance. I used ANCOVA for Research Questions 2-4 to determine any differences with covariables gender, education, and race. I used these analyses to answer the following research questions:

RQ1: Is there a difference between lower-income groups and higher income groups measured for the uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet?

H_{01} : There is no difference between lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

H_{11} : There is a difference between lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

RQ2: Is there a mean difference between gender count (Male and Female) among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet?

H₀2: There is no mean difference between gender count (Male and Female) among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

H₁2: There is a mean difference between gender count (Male and Female) among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

RQ3: Is there a difference between education level among lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet?

H₀3: There is no difference between education level among lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

H₁3: There is a difference between education level among lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition

with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

RQ 4: Is there a difference between race among lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet?

H₀4: There is no difference between race among lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

H₁4: There is a difference between race among lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

The variables I used from the demographics dataset include gender of the participants completing the survey, Race including Hispanic origin and Non-Hispanic Asian, and each respondents education level of adults age 19+, age in years at screening. Gender is a nominal binary variable of Male and Female and did not require recode. Table 1 shows the frequency of the gender of respondents. Race is a nominal categorical variable consisting of Race/Hispanic origin Mexican American, Other Hispanic, Non-Hispanic White, Non-Hispanic Black, Other Race - Including Multi-Racial. The Race variable did not require any changes.

Table 1*Gender of Respondents*

Gender		Frequency	Valid percent
Valid	Male	2769	48.5
	Female	2943	51.5

Note. N=9254 (n=5712). Gender of respondents were categorized by conventional binary self-identification of male or female.

Table 2 is the frequency of race. The variable education level for adult 20+ is an ordinal scale consisting of less than 9th grade, 9-11th grade (Includes 12th grade with no diploma), high school graduate/GED or equivalent, some college or AA degree, college graduate or above, refused, don't know, or missing.

Table 2*Race/Hispanic Origin w/ NH Asian*

		Frequency	Valid percent
Valid	Mexican American	764	13.4
	Other Hispanic	536	9.4
	Non-Hispanic White	1985	34.8
	Non-Hispanic Black	1321	23.1
	Non-Hispanic Asian	822	14.4
	Other race including multi-racial	284	5.0

Table 3 is a frequency of the education level for adults age 20+ and represents the respondent completing the survey. The amount of people who self-reported to having less than a ninth-grade education is 8.9%. Those who did not graduate but reached a ninth-grade level at minimum totaled 11.5%. Those with higher education were most of the

respondents with 23.8% holding a high school diploma or equivalent, 31.1% had 2 years of college level education, and 23.4% held a bachelor's degree or above.

Table 3

Frequencies for Education Level - Adults 20+

		Frequency	Valid Percent
Valid	Less than 9th grade	479	8.6
	9th-11th including 12th grade no diploma	638	11.5
	High school graduate/GED	1325	23.8
	Some college or AA degree	1778	31.9
	College graduate or above	1336	24.0
	Refused	2	.0
	Don't know	11	.2
Missing	System	143	

Note. n=5569 Adults age 20+ are included in the table with 143 missing. The limitation of age for this study includes adults 19+ and the data set includes respondents appropriate to this study as the individual providing a response on the survey.

The variable for ratio of family income to poverty guidelines is used to identify respondents who fall into income categories “income deficit (for families in poverty) or income surplus (for families above poverty),” according to United States Census Bureau (2021). To designate for the groups of lower and higher income, I recoded the families income to poverty ratio scale variable of 0 through 5 into a binary variable of high- and low-income groups to compare differences for the dependent variable uptake of PBN and the independent variable awareness of MyPlate nutrition. The original code for the variable provides a score of 5.00 on the scale are respondents who are above the poverty line or are considered income surplus. The scale variable is recoded to 0.1 through 4.98

for low-income as those respondents are considered in poverty based on the original codes for the dataset. Those respondents who scored 4.99 through 5.00 are recoded into the binary variables as high-income categories. The descriptive frequencies for the high- and low-income variable are presented in Table 4 with 69.2% of respondents in the low-income category for poverty ratio and 14.8% in the high-income category or income surplus.

Table 4

Low- and High-Income Groups

		Frequency	Valid percent
Valid	Missing	910	15.9
	Low income	3954	69.2
	High income	848	14.8

Note. N=5712 Ratio of family income to poverty for respondents who fall into categories for income deficit or income surplus.

The questionnaire dataset subcategory diet behavior and nutrition variables include Heard of My Plate, Looked up My Plate on internet, and Tried My Plate plan were used for the independent variable awareness of plant-based nutrition and the American Nutritional suggestions for optimal health eating. Compliance to plant-based eating was determined by using the variables do you drink whole or regular milk, do you drink soy milk, and do you drink another type of milk. Respondents who answered yes to drinking whole or regular dairy milk were considered non-compliant to the PBN eating pattern. Respondents answering yes to drinking soy were considered possibly non-compliant, and those answering yes to another type of milk were considered compliant to

PBN. Dairy alternatives for the answer to another type of milk include nut based or oat-based products to create a nondairy milk replacement. The variables from the diet and behavior questionnaire “you drink soy,” and “you drink another milk” are considered compliant variables regarding a plant-based diet as defined by Ostfeld (2017). The uptake of plant-based nutrition is determined by respondents adherence to the foods that are considered fully compliant, such as other alternatives to dairy. To determine PBN compliancy, I recoded each of the variables into a different categorical scale variable for PBN compliancy. Noncompliance is determined as those respondents who chose dairy. I recoded the binary nominal variables for dairy, soy, and other into a compliancy scale variable. Those respondents who answered yes to the question do you drink dairy milk were considered noncompliant to plant-based nutrition. Dairy is considered completely noncompliant to the PBN diet. Respondents who answered yes to the question do you drink soy milk were considered less likely to be compliant or have medium compliancy to a PBN diet for the sake of this study. Although soy-based milk is considered a plant-based food it does not fully determine the likelihood of someone choosing a plant-based eating style and is considered a medium possible compliance or noncompliance for the sake of this study. The independent variable for awareness is defined by the variables “heard of MyPlate,” “looked up MyPlate,” and “tried MyPlate.” Each response is the corresponding answer when participants of the primary study were asked about their familiarity and experience with the American Nutritional Guidelines as outlined in the MyPlate visual display for public education on nutrition and health (ODPHP, 2020). Familiarity with MyPlate and how respondents obtained the nutritional information

indicates awareness for the purpose of this study. I recoded the independent variable for awareness from the three nominal variables “tried MyPlate,” “heard of MyPlate,” and “looked up MyPlate on the internet” to create a categorical measure for awareness of nutritional education. Respondents chose yes or no to the questions for have you tried MyPlate, heard of MyPlate, or looked up MyPlate on the internet.

Recoding the Dependent Variable

The dependent variable for uptake of plant-based nutrition is created by recoding into a different variable from three binary nominal variables in the NHANES dataset. Each variable was recoded to show those who answered yes or no to the questions regarding uptake of compliant or noncompliant milk product and adjusted to create a ratio scale variable for analysis. A derivation of the nominal categorical binary data was necessary to answer the research questions and is productive in research to support better understanding in the social sciences and behavior (Lionello et al., 2021). Creating a continuous scale from categories and binary responses can provide measurable intervals to analyze with statistical significance (Sullivan & Artino, 2013). Respondents answered yes or no to the questions do you drink dairy, do you drink soy, and do you drink another type of milk than dairy. The three variables were recoded into a different variable to identify when respondents marked yes to each question. I transformed into a new variable a compliancy scale with 7 levels of compliancy based on the respondents answers. In SPSS, the responses are listed from least to most compliant. The descriptive frequencies for the dependent variable uptake of compliancy are shown in Table 5 and represents the responses from the survey. Those respondents who answered yes to dairy only were

considered least compliant or noncompliant on the scale and represent 0.27% of the population sample because individuals who consume dairy are not compliant to plant-based eating. Respondents who answered yes to only the nondairy milk or other type of milk were considered fully compliant to the plant based nutritional plan because this would fully exclude dairy products and include dairy alternatives such as nut, oat, or pea-protein milks. Eight percent of the respondents were considered fully compliant meaning they chose only a plant-based non-dairy milk alternative and the exclusion of soy products. From a scale of zero to seven, respondents answered yes if they did or did not drink dairy, soy, or another type of nondairy milk. Respondents were able to mark all three as yes or no and a scale of compliance is created from the level of use. Respondents who answered yes to only dairy were considered the least compliant or noncompliant to plant-based nutrition. When respondents answered yes to both dairy and soy, they are given a level up toward compliancy which is represented by the number two on the scale. Respondents answering other type of nondairy milk and dairy products are moved a level up toward compliance with the plant-based diet. The next level is represented by those who responded yes to all three options of other nondairy type of milk, soy, and dairy. Soy is a plant-based milk alternative, although it is considered noncompliant for the purpose of this study and is closer to compliance regarding the scale. The next level is respondents answering yes to both soy and other nondairy milk alternatives. Last, the highest level of compliance to the PBN diet is for respondents who answered yes to only the other type of nondairy milk alternative. About 0.62% did not respond yes or no to either of the three options for dairy, soy, or other milk alternative.

Table 5*Dependent Variable for Uptake of PBN*

		Frequency	Valid percent
Valid	Missing	3546	62.1
	Dairy least level of compliancy	1544	27.0
	Dairy & soy	5	.1
	Other and dairy	21	.4
	Other, soy, and dairy	2	.0
	Soy	121	2.1
	Other & soy	12	.2
	Other highest level of compliancy	461	8.1

Note. The compliancy scale for uptake or adherence to PBN from a scale measuring from one least to seven most compliant to PBN.

Recoding of Independent Variable

The independent variable for awareness of plant-based nutritional compliant foods variable is recoded into a categorical variable from three binary nominal variables where respondents were asked if they have ever heard of MyPlate nutritional guidelines in one single binary variable, tried MyPlate for themselves in a second binary response variable, or looked up the MyPlate on the internet as the third binary variable. The independent variable is categorical representing those respondents who answered yes, no, don't know, refused, or missing to each response. Respondents who answered don't know or refused were recoded as missing. Table 6 represents the frequency for respondents who answered the three questions. Respondents had the ability to make all, some, or one of the answers. Most respondents had never heard of or tried MyPlate for themselves representing 0.79% of population sample. The same respondents also

answered no to having never searched it out for themselves on the internet. Ten percent of respondents had heard of MyPlate before but only 0.3% had tried the MyPlate suggestions after hearing about it. The rate of respondents who answered yes to all three is 3.7% whereas each had not only heard about MyPlate but also looked it up on the internet and went on to try it for themselves.

Table 6

Independent Variable for Awareness of PBN

		Frequency	Valid percent
Valid	No have not heard, tried, or looked up MyPlate	4565	79.9
	Heard of MyPlate	555	9.7
	Heard of and tried MyPlate	189	3.3
	Heard of and looked up on internet	191	3.3
	Looked up, heard about, and tried MyPlate	212	3.7

Note. Respondents to the survey were asked if they have heard of, tried, or looked up on the internet the MyPlate nutritional guidelines for themselves.

RQ1 Analysis of Variance for Income Groups

To test the null hypothesis of no difference between lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate, an ANOVA general linear model was conducted using SPSS software version [28.0]. The population sample of 128 was calculated using a sample calculation G Power Statistical Power Analyses for Mac and Windows (Faul et al., 2007). Figure 5 is a line diagram for both low- and high-income groups for uptake and awareness of MyPlate estimated marginal means for compliancy to

PBN. The between subjects factors are presented in table 7 with lower-income respondents n=3954 compared to higher-income respondents n=848. The coding for each variable and frequency are presented in the table as well. Respondents who have not heard, tried, or looked up MyPlate on the internet were the majority n=4565. Respondents who have heard about, tried, and looked up MyPlate on the internet n=212 are considered those with the most awareness of the nutritional guidelines. There are 910 missing responses for income groups, with low-income groups n=3954 representing most respondents and high-income n=848.

Figure 5

Income and Awareness

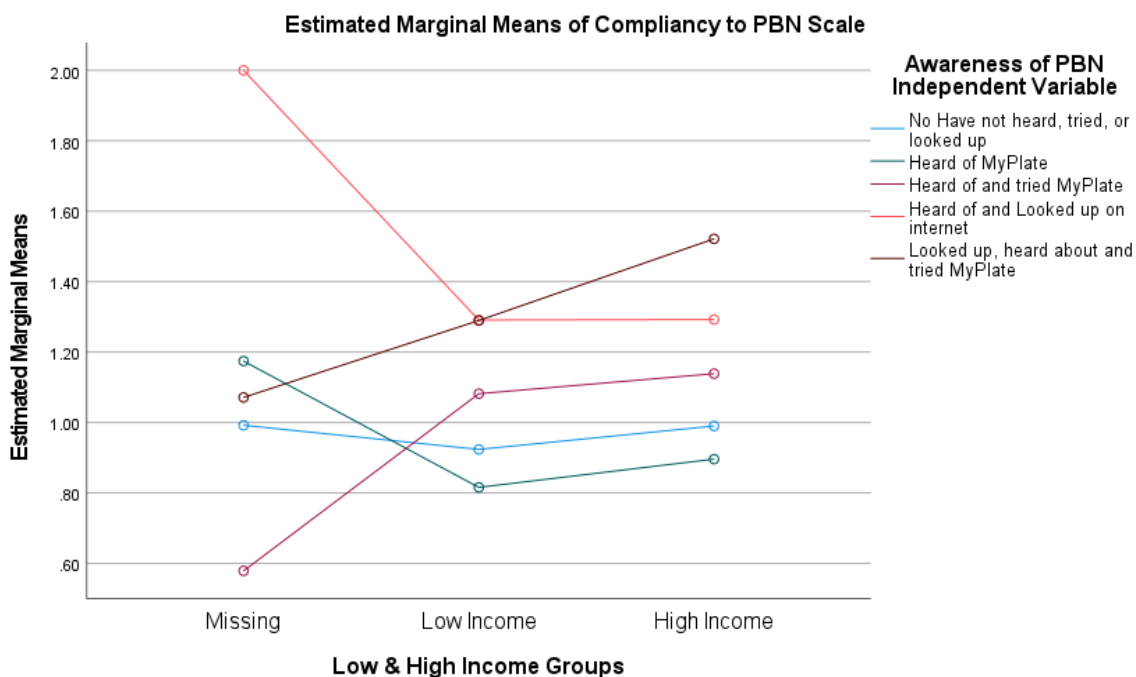


Table 7*Between-Subjects Factors*

	Code	Value label	N
Low- & High-Income Groups	.00	Missing	910
	1.00	Low income	3954
	7.00	High income	848
Awareness of PBN	.00	No have not heard, tried, or looked up	4565
	1.00	Heard of MyPlate	555
	11.00	Heard of and tried MyPlate	189
	31.00	Heard of and looked up on internet	191
	41.00	Looked up, heard about, and tried MyPlate	212

The statistical understanding of lower income group ($M = 0.9439$, $SD = 1.94144$, $n = 3954$) and higher income group ($M = 1.0283$, $SD = 2.16534$, $n = 848$) is presented in table 8. A Levene's test of equality of error variance is represented in Table 9 using the Bonferroni post hoc test to reduce the possibility of a false positive showed the variance between groups $F(14) = p < 0.001$ for the assumption of homogeneity is statistically significant.

Table 8*Descriptive Statistics for Compliance to PBN Scale*

Low- & High-Income Groups	Awareness of PBN Independent Variable	Mean	Std. Deviation	N
Missing	No Have not heard, tried, or looked up	.9923	1.94692	784
	Heard of MyPlate	1.1746	2.23275	63
	Heard of and tried MyPlate	.5789	1.60955	19
	Heard of and looked up on internet	2.0000	2.98887	16
	Looked up, heard about, and tried MyPlate	1.0714	2.12444	28
	Total	1.0165	1.99028	910
Low Income	No Have not heard, tried, or looked up	.9238	1.88910	3162
	Heard of MyPlate	.8161	1.84175	386
	Heard of and tried MyPlate	1.0821	2.18693	134
	Heard of and looked up on internet	1.2910	2.45202	134
	Looked up, heard about, and tried MyPlate	1.2899	2.46790	138
	Total	.9439	1.94144	3954
High Income	No Have not heard, tried, or looked up	.9903	2.10791	619
	Heard of MyPlate	.8962	1.98052	106
	Heard of and tried MyPlate	1.1389	2.33180	36
	Heard of and looked up on internet	1.2927	2.58112	41
	Looked up, heard about, and tried MyPlate	1.5217	2.74663	46
	Total	1.0283	2.16534	848
Total	No Have not heard, tried, or looked up	.9446	1.92992	4565
	Heard of MyPlate	.8721	1.91607	555
	Heard of and tried MyPlate	1.0423	2.16065	189

Heard of and Looked up on internet	1.3508	2.52096	191
Looked up, heard about, and tried MyPlate	1.3113	2.48164	212
Total	.9680	1.98396	5712

Table 9

Levene's Test of Equality of Error Variances

		Levene	df1	df2	Sig.
		Statistic			
Compliance to PBN Based on Mean Scale	Based on Mean	7.858	14	5697	<.001
	Based on Median	1.614	14	5697	.067
	Based on Median and with adjusted df	1.614	14	5481.059	.068
	Based on trimmed mean	5.663	14	5697	<.001

The test between subject effects represented in table 10 show a statistically significant difference between awareness and income $F = 2.68$, $p < .05$. The Eta Squared ($\eta^2 = .002$) shows that awareness contributes to compliance by 0.02%. The Bonferroni post-hoc test showed that awareness among groups differ significantly ($p < 0.001$). The statistical significance of 0.03 ($p = 0.05$) for awareness of plant-based nutrition is statistically significant for uptake 0.001 ($p = 0.05$) but uptake of compliance is not significant between income groups 0.75 ($p = 0.05$). The between groups effects for income and awareness is not statistically significant. Therefore, I failed to reject the null hypothesis that there is no difference between lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness of

nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

Table 10

Test Between Subjects Effects for Compliancy to PBN Scale

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	88.819 ^a	14	6.344	1.614	.067	.004
Intercept	1046.808	1	1046.808	266.350	<.001	.045
INCOME Groups	2.265	2	1.132	.288	.750	.000
IV Awareness	42.211	4	10.553	2.685	.030	.002
INCOME Groups Awareness	20.053	8	2.507	.638	.747	.001
Error	22390.318	5697	3.930			
Total	27831.000	5712				
Corrected Total	22479.137	5711				

a. R Squared = .004 (Adjusted R Squared = .002)

RQ2-Analysis of Covariance for Gender

To test the null hypothesis of no mean difference between gender count (Male and Female) among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition an ANCOVA was conducted using SPSS software version [28.0]. I used G Power calculations for the research questions with covariates for an ANCOVA with means difference between two independent groups, two tailed test with medium effect size for practical significance, and an alpha level 0.8 results for sample size minimum of 64 for each group. A medium effect size indicates a practical significance or meaningful differences between groups. Table 11 represents the between subject factors for gender with Males $n = 2769$ and Females $n = 2943$. Table 12 represents the descriptive statistics for gender and

compliance to PBN with SD = 1.8 Males and SD = 2.1 Females. The Levene's test of equality of error variances tests the null hypothesis that the error variance of the dependent variable is equal across groups.

Table 11

Analysis of Variance for Gender Between Subjects Factors

	Value	
	Label	N
Gender 1	Male	2769
2	Female	2943

Note. Univariate analysis of variance for gender.

Table 12

Descriptive Statistics for Gender and Compliance to PBN

Gender	Mean	Std. Deviation	N
Male	.8433	1.78647	2769
Female	1.0853	2.14701	2943
Total	.9680	1.98396	5712

The Levene's test of equality of error variance is represented in table 13 is statistically significant $p = 0.001$ of the groups having a mean difference.

Table 13

Levene's Test of Equality of Error Variances

Dependent Variable: Compliance to PBN Scale			
F	df1	df2	Sig.
74.134	1	5710	<.001

The test between subject effects shows a statistically significant mean difference for covariate gender $p = 0.001$ for awareness in table 14. The Eta Squared ($\eta^2 = .003$) shows that there is a 3% mean difference for gender and uptake and statistically significant mean differences for awareness and uptake $p = 0.001$.

Table 14

Tests of Between Subjects Effects for Compliancy to PBN Scale

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	122.992 ^a	2	61.496	15.704	<.001	.005
Intercept	4558.906	1	4558.906	1164.190	<.001	.169
IV Awareness	39.424	1	39.424	10.068	.002	.002
GENDER	66.955	1	66.955	17.098	<.001	.003
Error	22356.146	5709	3.916			
Total	27831.000	5712				
Corrected Total	22479.137	5711				

Note. a. R Squared = .005 (Adjusted R Squared = .005).

Table 15 represents the Parameter estimates for Males statistically significant $p = 0.001$ for awareness $p = 0.003$. The statistical understanding is that there is a 3% mean difference for Males than for Females for uptake of PBN and awareness. Therefore, I reject the null hypothesis of no mean difference between gender count among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition.

Table 15*Parameter Estimates for Compliancy to PBN*

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval		Partial Eta Squared
					Lower Bound	Upper Bound	
Intercept	1.047	.038	27.273	<.001	.972	1.123	.115
IV Awareness	.009	.003	3.173	.002	.003	.014	.002
Male 1	-.219	.053	-4.135	<.001	-.322	-.115	.003
Female 2	0 ^a	.	.	.	.	.	.

Note. a. This parameter is set to zero because it is redundant.

RQ3-Analysis of Covariance for Race

To test the null hypothesis of no mean difference between race among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition an ANCOVA was conducted using SPSS software version [28.0]. I used G Power calculations for the research questions with covariates for an ANCOVA with means difference between two independent groups, two tailed test with medium effect size for practical significance, and an alpha level 0.8 results for sample size minimum of 64 for each group. A medium effect size indicates a practical significance or meaningful differences between groups. The between subjects factors for race shown in table 16 provides the value label, code, and frequency. The descriptive statistics for race are provided in table 17 $M = 9.7$, $SD = 2.0$, $n = 5712$.

Table 16*Between Subjects Factors for Race*

		Value Label	N
Race/Hispanic origin w/ NH	1	Mexican American	764

Asian	2	Other Hispanic	536
	3	Non-Hispanic White	1985
	4	Non-Hispanic Black	1321
	6	Non-Hispanic Asian	822
	7	Other Race including Multi-Racial	284

Note. Race is coded from 1-7 without regard to level of association.

Table 17

Descriptive Statistics for Dependent Variable Compliancy to PBN Scale

Race/Hispanic origin w/ NH Asian	Mean	Std. Deviation	N
Mexican American	1.0118	2.06541	764
Other Hispanic	1.3582	2.40141	536
Non-Hispanic White	.7134	1.68393	1985
Non-Hispanic Black	1.1930	2.20017	1321
Non-Hispanic Asian	.8966	1.80006	822
Other Race including Multi-Racial	1.0528	2.04041	284
Total	.9680	1.98396	5712

The Levene's test of equality of variance in table 18 is statistically significant $p = 0.001$ for a mean difference in groups for race. The test between subjects effects in table 19 shows a statistically significant mean difference for covariate race $p = 0.001$ for awareness. The Eta Squared ($\eta^2 = .013$) shows that there is a 13% difference for race and uptake.

Table 18

Levene's Test of Equality of Error Variances for Compliancy to PBN

F	df1	df2	Sig.
30.751	5	5706	<.001

Table 19*Tests of Between Subjects Effects for Compliancy to PBN*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	345.459 ^a	6	57.577	14.840	<.001	.015
Intercept	3701.228	1	3701.228	953.999	<.001	.143
RACE	289.422	5	57.884	14.920	<.001	.013
IV Awareness	60.530	1	60.530	15.602	<.001	.003
Error	22133.678	5705	3.880			
Total	27831.000	5712				
Corrected Total	22479.137	5711				

Table 20 represents the Parameter estimates for Race and uptake compliancy statistically significant for Other Hispanic $p = 0.02$ and non-Hispanic White $p = 0.008$ for uptake of compliant nutrition. Awareness among race was statistically significant $p=0.001$. The statistical understanding is among Hispanic and non- Hispanic White there is a 13% mean difference for uptake of PBN and awareness. Therefore, I reject the null hypothesis of no mean difference between race among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition.

Table 20*Parameter Estimates for Race and Compliancy to PBN*

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval		Partial Eta Squared
					Lower Bound	Upper Bound	
Intercept	1.009	.117	8.592	<.001	.779	1.239	.013
Mexican	-.027	.137	-.198	.843	-.296	.241	.000
Other Hispanic	.327	.145	2.260	.024	.043	.611	.001

White	-.330	.125	-2.639	.008	-.575	-.085	.001
Black	.150	.129	1.162	.245	-.103	.402	.000
Asian	-.144	.136	-1.064	.287	-.410	.122	.000
Multi-Racial	0 ^a	.	.	.	.	.	.
IV Awareness	.011	.003	3.950	<.001	.005	.016	.003

Note. a. This parameter is set to zero because it is redundant.

RQ4-Analysis for Covariance for education Level

To test the null hypothesis of no mean difference between education level among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition an ANCOVA was conducted using SPSS software version [28.0]. I used G Power calculations for the research questions with covariates for an ANCOVA with means difference between two independent groups, two tailed test with medium effect size for practical significance, and an alpha level 0.8 results for sample size minimum of 64 for each group. A medium effect size indicates a practical significance or meaningful differences between groups. Table 21 represents education level with codes and frequency for each category. Adult respondents who have less than a 9th grade education n= 479, some high school with no diploma n=638, graduated high school or equivalent n = 1325, some college n =1778, and college degree n = 1336 are presented in the table.

Table 21

Education Level Codes and Frequencies

		Value Label	N
Education level - Adults 20+	1	Less than 9th grade	479
	2	9th-11th including 12th grade no diploma	638

3	High school graduate/GED	1325
4	Some college or AA degree	1778
5	College graduate or above	1336
7	Refused	2
9	Don't know	11

Table 22 represents the descriptive statistics for education level. The Levene's test of equality of error variances tests the null hypothesis that the error variance of the dependent variable is equal across groups. In Table 23 the Levene's test shows statistically significant $p = 0.001$ of the groups having a mean difference.

Table 22

Descriptive Statistics for Education Level

Education level - Adults 20+	Mean	Std. Deviation	N
Less than 9 th grade	.8017	1.64289	479
9 th 12th grades no diploma	.7931	1.58421	638
High school graduate/GED	.7970	1.68528	1325
Some college or AA degree	1.1125	2.20394	1778
College graduate or above	1.1272	2.23127	1336
Refused	2.5000	3.53553	2
Don't know	1.1818	1.99089	11
Total	.9783	1.99345	5569

Table 23

Levene's Test of Equality of Error Variances

Dependent Variable: Compliancy to PBN Scale

F	df1	df2	Sig.
28.593	6	5562	<.001

Note. Tests the null hypothesis that the error variance of the dependent variable is equal across groups. Design intercept and independent variable awareness.

The test between subject effect in table 24 shows a statistically significant mean difference for covariate education level $p = 0.001$ for uptake and awareness Eta Squared ($\eta^2 = .005$) that there is a 5% difference. Also, there is a statistically significant mean differences for awareness $p = 0.002$ Eta Squared ($\eta^2 = .002$) for a 2% difference between awareness and education level.

Table 24

Test of Between Subjects Effects

Dependent Variable: Compliancy to PBN Scale

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	186.056 ^a	7	26.579	6.737	<.001	.008
Intercept	111.852	1	111.852	28.350	<.001	.005
IV Awareness	38.929	1	38.929	9.867	.002	.002
EDUCATION	120.547	6	20.091	5.092	<.001	.005
Error	21940.315	5561	3.945			
Total	27456.000	5569				
Corrected Total	22126.371	5568				

Note. a. R Squared = .008 (Adjusted R Squared = .007).

The Parameter estimates for educational level among adult respondents are shown in table 25 and are statistically significant $p = 0.002$ CI 0.05 Eta Squared ($\eta^2 = .002$) for a 2% difference for awareness.

Table 25*Parameter Estimates for Education Level Categories*

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval		Partial Eta Squared
					Lower Bound	Upper Bound	
Intercept	1.147	.599	1.915	.056	-.027	2.321	.001
IV Awareness	.009	.003	3.141	.002	.003	.015	.002
Less than 9th	-.347	.606	-.573	.566	-1.535	.840	.000
High w/o diploma	-.364	.604	-.602	.547	-1.548	.820	.000
High school GED	-.364	.601	-.606	.545	-1.543	.815	.000
Some college	-.069	.601	-.114	.909	-1.246	1.109	.000
College Grad	-.064	.601	-.107	.915	-1.243	1.115	.000
Refused	1.353	1.527	.886	.376	-1.640	4.347	.000
Don't know	0 ^a	.	.	.	.	.	.

The parameter estimates for awareness in table 26 presents the level of awareness with CI 0.05 respondents who were not aware of MyPlate were statistically significant $p = 0.03$ and those who have heard of MyPlate were statistically significant at $p = 0.01$. The statistical understanding is that there is a difference for awareness categories of heard of MyPlate and among those who have no awareness and the uptake of PBN. Therefore, I reject the null hypothesis of no difference between education level measured for uptake of plant-based compliant nutrition with an awareness of nutrition.

Table 26*Parameter Estimates for Awareness*

Parameter	B	Std. Error	t	Sig.	95% Confidence Interval		Partial Eta Squared
					Lower Bound	Upper Bound	
Intercept	.913	.169	5.400	<.001	.581	1.244	.005
[0.00] Not aware	-.309	.146	-2.114	.035	-.595	-.022	.001
[1.00] Heard of MyPlate	-.407	.166	-2.449	.014	-.733	-.081	.001
[11.00] Heard & tried MyPlate	-.228	.205	-1.113	.266	-.630	.174	.000
[31.00] Heard & looked up on internet	.088	.205	.427	.669	-.315	.490	.000
[41.00] Aware of MyPlate-Heard, looked up & tried EDUCATION	0 ^a	.	.	.	.	.	.
	.101	.022	4.622	<.001	.058	.144	.004

Note. a. This parameter is set to zero because it is redundant.

Summary

An ANOVA general linear model was conducted using SPSS to answer research question one to test the null hypothesis of no difference between lower-income groups and higher income groups measured for uptake of plant-based compliant foods with an awareness of the nutritional guide MyPlate. The between groups effects for income and awareness is not statistically significant for awareness and uptake. Therefore, I failed to reject the null hypothesis that there is no difference between lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an

awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet.

An ANCOVA was used to answer research question two to test the null hypothesis of no mean difference between gender count (Male and Female) among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition. The test between subject effect shows a statistically significant mean difference for covariate gender. The statistical understanding is that there is a 3% mean difference for Males than for Females for uptake of PBN and awareness. Therefore, I reject the null hypothesis of no mean difference between gender count among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition.

An ANCOVA was conducted using SPSS to answer research question three to test the null hypothesis of no mean difference between race among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition. There is a 13% mean difference for uptake of PBN and awareness among Hispanic and White groups. Therefore, I reject the null hypothesis of no mean difference between race among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition.

An ANCOVA was conducted using SPSS to answer research question four to test the null hypothesis of no mean difference between education level among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition. The statistical understanding is that there is a difference for

awareness categories of heard of MyPlate and among those who have no awareness and the uptake of PBN. Therefore, I reject the null hypothesis of no difference between education level measured for uptake of plant-based compliant nutrition with an awareness of nutrition.

Section 4: Application to Professional Practice and Implications for Social Change

Introduction

Chronic disease accounts for 86% of the annual healthcare expenditures in the United States (Centers for Disease Control and Prevention, 2017), and nutritional education among vulnerable populations is instrumental in developing programs and policies for healthier outcomes and more efficient economic developments. In this study, I observed any differences between socioeconomic conditions and uptake to plant-based compliant nutrition and awareness level of MyPlate nutritional guidelines with covariables gender, education, and race from an adult population sample using the 2017-18 NHANES dataset. This study contributes to previous research on nutritional studies supporting the effectiveness of nutritionally dense foods by providing insight into implementing best-fit designs to capture compliant variables for further research and design. This study also builds from previous research to provide evidence to support the need for further research in plant-based nutritional uptake among vulnerable populations and analysis of outcomes regarding the HBM.

Summary of Key Findings

Using an ANOVA to analyze nutritional uptake, education awareness, and socioeconomic variables with the theoretical framework of the HBM, Nooriani et al. (2019) showed that the model could be more successful in nutritional education among diverse groups. However, greater variance of time for interventions using the model is needed for assessing intake and awareness of compliant nutrition. An ANOVA with regression showed there is no difference between income groups as a factor in whether respondents

implemented plant-based compliant foods into their diets and of nutritional awareness concerning the American Nutritional Guidelines visual of MyPlate design. Research questions for covariates race, gender and education were conducted using an ANCOVA and showed there is a 3% mean difference between Males and Females for uptake of plant-based compliant nutrition and awareness. There is a 13% mean difference for uptake and awareness regarding covariate races and ethnicity for Hispanic and White populace. An ANCOVA for covariate education level showed that there is a difference among education level for respondents who have heard of MyPlate and those who were unaware of MyPlate (had not heard of, looked up on the internet, or tried MyPlate) and uptake of compliant foods. Uptake was higher among those who had only heard of MyPlate or those who were completely unaware of MyPlate nutritional guidelines. The application to professional practice may provide social change through public health awareness programs and policy on nutritional awareness to increase health literacy and reduce chronic disease rates among a vulnerable populace in the United States. Understanding and promoting uptake of nutritionally dense foods among vulnerable populations is a critical component of public health and policy adoption for effective interventions and healthcare expenditures.

Interpretation

Research Question 1

An ANOVA was used to answer Research Question 1 to test the null hypothesis of no difference between lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of

MyPlate. The between groups effects for income and awareness were not statistically significant for awareness and uptake. Therefore, I failed to reject the null hypothesis that there is no difference between lower-income groups and higher income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition by knowledge of the MyPlate or if respondents looked up MyPlate on the internet. The significance of this finding is that income is not a factor in whether respondents implemented plant-based compliant foods into their diets. However, there were differences for awareness level of nutritional education of the MyPlate guidelines. Most people in both income groups were unaware of the MyPlate nutritional guidelines and were noncompliant to plant-based eating habits. Respondents in the higher income group with the lowest level of compliancy were also unaware of the MyPlate design. Awareness and compliancy level was significant, but income level did not have influence. No difference between income groups is a successful outcome for this analysis and could mean positive social change in future research and public health practice in a broader view of socio-economic status. Income level may not be a factor for implementing programs in nutritional education or in policy developments. The low level of compliance among those who were completely unaware of the MyPlate design for both income groups is significant regarding nutritional awareness and uptake initiatives. Respondents from both income groups who had no awareness also had an extremely low level of compliance toward plant-based nutrition which extends upon the findings of Pescud and Pettigrew (2014) that one of the barriers to uptake in plant-based compliant eating is the lack of awareness. This study extends on the findings of French et al. (2019) that lower

socioeconomic groups may be more susceptible to chronic illnesses, but low awareness of dietary knowledge is not limited to income status. Lee et al. (2015) argued that patients are willing to make the necessary dietary changes if the information is provided.

Research Question 2

An ANCOVA was used to answer Research Question 2 to test the null hypothesis of no mean difference between gender count (Male and Female) among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition. There was statistical significance in the mean difference for Males than for Females by 3% for uptake and awareness among income groups. I rejected the null hypothesis of no mean difference between gender count among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition. Men in lower income groups are more likely to be unaware of MyPlate nutritional guidelines and noncompliant to plant-based eating. The significance of this analysis is that Males within a lower income group have a lower level of awareness of plant-based nutrition and higher uptake of noncompliant plant-based nutrition than for Females. A review of the Male role in public health nutritional education dissemination could result in positive social change as further study observes whether the male role in decision making with food has been overlooked. McKenzie et al. (2022) found that culture and gender were crucial components of local and government public health policy using a “gender-responsive” action. Further research in nutritional education among low-income men in the United States using HBM uptake of compliant plant-based nutrition could expand on professional practice in navigating policy

development which may have neglected the male role in the home. This study supports the findings of McKenzie et al. (2022) who cited the World Health Organization's gender analysis tool as a resource for understanding the vulnerability of gender nutritional inequalities in policy development. In addition, this study's contribution to the gap in literature provides evidence that gender inequality is a crucial factor in the development of nutritional programs and initiatives.

Research Question 3

To test the null hypothesis of no mean difference between race among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition an ANCOVA was conducted using SPSS. There is a statistical difference among races for uptake of compliant foods and awareness level of MyPlate design. The understanding is that among the groups who identified as Other Hispanic and non-Hispanic White there is a 13% mean difference in choosing foods that are compliant with a plant-based diet and awareness of the MyPlate guidelines. The social significance of this research is that Non-Hispanic White and Other Hispanic low-income groups are more likely to be unaware of plant-based nutrition and have least level of compliancy to plant-based nutrition. The results are supported by the findings of Parcha et al. (2020) with higher rates of hypertension among non-Hispanic Black and White groups using the NHANES data. It is important for public health professionals to investigate race inequality in nutritional awareness and uptake through autonomous survey styles that provide more details of perception and barriers (Díaz Rios, 2022). There are limited studies in nutrition regarding race and awareness of nutrition (Ma et al.,

2022). Further research is needed to address the noncompliance among race groups in lower income status and whether American standard dietary perceptions is a factor in the performance of nutritional education and any cultural significance.

Research Question 4

To test the null hypothesis of no mean difference between education level among lower-income and higher-income groups measured for uptake of plant-based compliant nutrition with an awareness of nutrition an ANCOVA was conducted using SPSS. The statistical understanding is that there is a difference in education level for awareness categories of heard of MyPlate and among those who have no awareness and the uptake of PBN. Therefore, I rejected the null hypothesis of no difference between education level measured for uptake of plant-based compliant nutrition with an awareness of nutrition. Using an ANCOVA there is a difference for awareness but under the category of completely unaware of MyPlate design. The respondents under the category for unaware of MyPlate would have answered no to having never heard of MyPlate, looked up MyPlate on the internet, and tried MyPlate. Therefore, findings showed that there was a difference among education level for respondents who heard of MyPlate and those who were not aware of MyPlate (had not heard of, looked up on the internet, or tried MyPlate) and uptake of compliant foods. There is statistical significance between education level for the uptake of compliant foods and respondents who had only heard of MyPlate or those who were completely unaware of MyPlate nutritional guidelines. Awareness is highest among the education levels college graduate or above for respondents who had heard of MyPlate, tried MyPlate, and looked up MyPlate on the internet. Most

respondents from the results were unaware of the design and noncompliance was highest among high school graduates or a GED equivalent and some college education or an associate degree. Level of education is a component of health literacy rates which is supported by Storz (2019) conclusions that the lack of nutritional education among health care providers might be a barrier to nutritional literacy for patients. Holston et al. (2020) stated that some barriers to evaluating food patterns among vulnerable groups are cultural, health literacy rates, and economic.

Interpretation of Results With Health Belief Model Context

The HBM constructs will influence the independent variable of awareness of MyPlate nutritional education. Perceived susceptibility, severity, benefits, and barriers among highly vulnerable populations are crucial in understanding the modes for positive change on a public health level and creating cues to action in all socioeconomic groups (Rosenstock, 1966). Respondents from both income groups who had no awareness also had an exceptionally low level of compliance toward plant-based nutrition which supports the theoretical framework of the HBM and extends upon the findings of Pescud & Pettigrew (2014) that barriers to uptake include the lack of awareness of dietary options. The HBM can be used to address streamlined access to nutritional information through public health initiatives supporting healthy decision-making from any socioeconomic status group. The HBM framework as a predictor of behavior shows a difference for gender, race, and education level among respondents in this study. Abraham & Sheeran (2007) stated that health behavior change is associated with practical approaches using the HBM framework for interventions considering socio-economic

factors. The constructs of the HBM can provide cues to action in public health initiatives to create an environment for efficacy among diverse populations considering demographic impacts. The variance found for the variables gender, race, and education level in the analysis of this study reinforces the need for further application of the HBM as a framework for future studies in nutritional education regarding gender, race, and education level. Individual perception is the potential for positive social change beyond barriers resulting in efficacy for the uptake of nutritional selection. Perception is affected by awareness programs, policy, and initiatives supporting the effectiveness of plant-based nutrition as noted by Corrin & Papadopoulos (2017). The self-efficacy component in nutritional education settings may be effective in positive social change targeting perceived susceptibility, perceived severity, perceived benefits, and perceived barriers with consideration to gender, race, and education level.

Limitations

The use of secondary data resulted in some limitations for this study regarding the availability of variables for clearly defining plant-based compliancy. The number of variables that comply with the plant-based diet were extremely limited within the nutritional questionnaire's dairy and nondairy milk alternatives. The compliance scale was constructed from the binary variables dairy and nondairy milk drinking options from the survey's results. The MyPlate design is a visual tool for public health educational awareness of PBN compliant foods. However, it is limited in exclusively promoting comprehensive compliance for plant-based consumption awareness. In addition, using secondary data from survey questionnaires also assumes that respondents are truthful in

their responses. As such, confounding variables for a plant-based diet (i.e., processed foods) are not measured in the NHANES dataset which weakens the ability to observe full compliance with plant-based nutrition. Studies in contrast to plant-based nutrition comprise the same limitations regarding compliance with the diet and advise further research considering these variables (Burkert et al., 2014).

Recommendations

The dietary guidelines advisory committee for 2025 nutritional guidelines meet to review an evidence-based scientific approach focusing on systematic reviews, data analysis, and food pattern modeling for an approach to health outcomes (USDA, n.d.). Some topics discussed for the 2025 guidelines include dietary patterns, added sugars, behavioral strategies, all-cause mortality, non-communicable diseases, and pregnancy and infant outcomes (USDA, n.d.). Cultural and budgetary concerns are considered in the implementation of the information to state, local and federal outlets for nutritional education (USDA, n.d.). The information is made available to the public through several social media outlets, making it very accessible to the public. Additionally, the information is written for professionals in the healthcare and public health setting for policy development, healthcare practice, educational programs, and all federal nutritional programs (USDA, n.d.). Appeals to strengthen nutritional education among medical students are addressing the barriers to patient education dissemination (Cuerda et al., 2023). However, further research to address the awareness and uptake of vulnerable populations will be required to understand the outcomes.

A further study on the specific variables for plant-based nutritional choices and perceptions which clearly define plant-based compliance among diverse demographics would provide clearer insight into the eating habits and educational frameworks for optimal health outcomes. The research on vegan diets should be more comprehensive in providing evidence-based measures for plant-based compliant choices and perceptions without the confounders of processed foods (Clarys et al., 2014). In agreement with Allès et al. (2017), additional research would address awareness of PBN and its effects on vulnerable populations. Narrowing nutritional survey questions to screen for more compliant variables is one recommendation for moving forward in more rigorous studies. Further research using a mixed methods approach with the adaptation of the constructs of the HBM would provide broader knowledge in the awareness and uptake of compliant nutrition.

The analysis for this study shows that income is not a factor in whether respondents implemented plant-based compliant foods into their diets contrasting the findings of Holston et al. (2020) that adherence to the nutritional guidelines is a barrier among lower-income groups. Males in a lower income group have a lower awareness of plant-based nutrition and higher uptake of noncompliant nutrition than Females. Non-Hispanic White and Other Hispanic low-income groups are likelier to be unaware of plant-based nutrition and have the least compliance with plant-based nutrition. Awareness is highest among the education levels college graduate or above for respondents who had heard of MyPlate, tried MyPlate, and looked up MyPlate on the internet. Most respondents from the results were unaware of the design, and

noncompliance was highest among high school graduates or a GED equivalent and some college education or an associate degree.

Further study is needed to observe compliance among racial groups with awareness to create a framework to address cultural perceptions of dietary choices for initiatives and policies. These findings agree with the Office of Disease Prevention and Health Promotion (2020) regarding the importance of eating patterns in understanding nutrient caloric intake. The results may contribute to reducing chronic disease and health expenditures which potentially burden communities' economic systems regarding gender and race differences. Understanding the male role in nutritional awareness and uptake could be critical to building from this study. Expanding on the research regarding race may provide a better understanding of the perceptions which differ culturally.

Respondents who were unaware of the design and with the highest level of noncompliance were high school graduates or a GED equivalent and some college education or associate degree. Further research on education level may be beneficial in reviewing policy development and the dissemination stage of the nutritional guidelines to the public.

Implications to Professional Practice and Positive Social Change

Implications to Professional Practice

This study contributes to professional practice by providing a framework for further studies to generate more defined variables to compliancy so eating patterns and perceptions of nutritional education can be better captured. The results of this study lay a foundation for further research to provide policy change and initiatives in public health

by showing a significant difference for racial groups, gender, and education level. There is an impact in understanding nutritional patterns among vulnerable or diverse groups and can influence positive change to the standard nutritional guidelines, which consider the male role, racial groups, and level of education in nutritional education programs. Public health professional practice may benefit from this study and the framework for higher levels of awareness and a more significant opportunity for the uptake of more compliant (i.e., healthier) foods. This study contributes to Public health practice by supporting evidence regarding education level in reviewing policy developments to disseminate the nutritional guidelines at age or education level appropriate phases.

Positive Social Change

This study applies to positive social change by observing nutritional patterns among a vulnerable population in the United States to expose the gap in research for nutritionally dense whole food studies regarding plant-based compliancy. Additionally, policy development for nutritional education requires a review of the American population's eating patterns and trending diets. The nutritional dietary guidelines are revisited every five years with evidence-based approaches to review future initiatives (United States Department of Agriculture, n.d.). However, diet trends and social norms toward nutrition are constantly changing. This study provides an understanding that there is still much to learn about the perceptions of nutritional education programs among the male role in the home. Public health systems focused on positive social health behavior outcomes would benefit by reviewing how these programs reach the male demographic. The same is true regarding race. Low-income White and Other non-Hispanic groups in

the United States were least aware of the MyPlate design for awareness toward plant-based compliancy. A better understanding of awareness and uptake of nutritional initiatives can create change in perceptions which should result in positive behaviors and outcomes. Changed behaviors can potentially reduce noncommunicable disease rates associated with nutrition. By looking at the uptake of plant-based compliant nutrition, where the focus is on whole fresh plant-based proteins, public health initiatives can encourage desired behavioral changes among vulnerable populations.

Conclusion

Chronic disease nutritional etiology is an important public health issue. The rising cost of health care expenditures in the United States associated with noncommunicable disease can affect the direction of public health policy and initiatives focused on nutritional education. Lower socioeconomic groups have been shown to be vulnerable to nutritional deficiencies and chronic health conditions. The findings of this study show no difference between lower-income and higher-income groups with awareness of the MyPlate nutritional guidelines. The results can be used as a framework to build on to further study for health promotion programming and policy development across multi-level income groups and target those who are more susceptible to chronic illness as noted by Tusso et al. (2013) as a “cost-effective and low-risk intervention.” This quantitative study aimed to observe any differences for the uptake of plant-based compliant nutrition which has been proven effective toward many chronic conditions and the awareness of MyPlate nutritional guidelines which has been promoted in the United States as a fundamental guide for optimal nutritional health (Kerley, 2018). An analysis of variance

with regression showed income is not a factor in uptake of plant-based compliant foods and awareness of nutrition by the MyPlate.

The research question for gender, using an ANCOVA, showed a 3% mean difference for Males than Females for uptake and awareness. Males in the lower income group had a lower level of awareness of plant-based nutrition and higher uptake of noncompliant plant-based nutrition than that of females. The result of this study shows the importance of future research regarding the male role in the home and the nutritional decision making that effects the health outcomes of those individuals and their families.

There is a 13% mean difference for uptake and awareness among respondents who self-identified as Other Hispanic and White. Non-Hispanic White and Other Hispanic low-income groups were unaware of plant-based nutrition and had the least level of compliancy to plant-based nutrition. Further research observing the perceptions of nutritional education programs among White and Hispanic racial demographics may prove successful in positive social change outcomes.

An ANCOVA was used to observe the educational level, and uptake was higher among those who had only heard of MyPlate. Respondents with higher education levels were unaware of the MyPlate nutritional guidelines and had responded to never heard of, tried, or looked up MyPlate on the internet. Uptake was significant among those groups who were unaware. Further research is needed to clearly define the specific variables for plant-based nutritional choices and perceptions among the U.S. population to provide insight into eating patterns through educational frameworks for optimal health outcomes. This study builds upon current literature and expands the knowledge in the area where

many confounders exist in vegan and vegetarian studies. It is crucial to continue the study of awareness and uptake of PBN and dietary choice as health expenditures increase in the United States. The application to professional practice may provide social change through public health awareness programs and policies on nutritional awareness to increase health literacy and reduce chronic disease rates among a vulnerable populace in the United States.

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