Nutrition Course and Culinary Demonstrations To Increase Perceived Importance of Nutrition in Medical Students

by

Makenna Baum

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Graduate Supervisory Committee:

Carol Johnston, Chair
Dorothy Sears
Simin Levinson

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ABSTRACT

Healthy lifestyle behaviors including quality nutrition have been shown to successfully prevent chronic disease or minimize symptoms. However, many physicians lack the knowledge and skills to provide adequate nutrition counseling and education for their patients. A major component of this problem is that medical schools are not required to teach nutrition education. The purpose of this feasibility study was to compare the changes in the perceived importance of nutrition in the medical field in medical students before and after participating in a week-long interactive nutrition course in order to determine if a week-long course can positively influence students' perceptions of nutrition. Ultimately by changing these perceptions, medical students may be able to better help patients prevent chronic disease. The participants were first year medical students at the Mayo Clinic School of Medicine (Scottsdale, AZ) who chose to participate in this medical school "Selective". The study included a five-day curriculum of case-studies, lectures from specialized health professionals, and a cooking class led by a chef who trained in France. An anonymous pre- and post-study questionnaire with five-point Likert scale questions was used to measure changes in attitudes. The data suggest that students' perceptions regarding the importance and relevance of nutrition in the medical shifted slightly more positive after attending this Selective, although these shifts in attitude were not statistically significant. Limitations of this study include a small sample size and selection bias, which may have decreased the potential of having significant results. Both of these factors also make the results of this study less generalizable to all medical students. This study supports the need for a larger experimental study of a similar design to verify that an interactive, evidence-based nutrition class and culinary

experience increases medical students' positive perceptions of nutrition in the medical field.

DEDICATION

To Mom, Dad, Jarrod, and my friends who have given me endless support, stayed up with me late at night, been understanding of my busy schedule, helped me relax when I needed it, and bought me tea and made me cookies to brighten my day. I love you all so much and really could not have gotten through this without you!

TABLE OF CONTENTS

APPENDICES Page

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

CHAPTER 1

INTRODUCTION

Overview

Chronic disease accounts for seven of the top ten causes of death in the United States[1]. The rise in chronic disease conditions over the past 50 years has resulted in thousands of dollars in individual healthcare spending, with over three trillion dollars in national healthcare costs in 2017[2]. Chronic disease unlike acute illnesses can affect a person for years, or sometimes their entire adult life, which inevitably causes major disruptions in daily life. Chronic disease can restrict daily living activities and prevent the afflicted from performing simple tasks such as walking, and clothing and feeding themselves[3]. It can put strain and stress on family members and caretakers who must change their own daily lives in order to assist their loved one[4]. Chronic disease is also often accompanied by a decline in mental health—both in the patient and their caretakers [4,5]. The United States healthcare system is in need of a more aggressive approach to preventing and managing chronic disease in order to help improve the quality of life of millions of Americans.

Healthy lifestyle behaviors such as quality nutrition, physical activity, and the omission of smoking have been shown to successfully prevent chronic disease[6] or minimize symptoms[7-9]. Diet alone is the primary risk factor and preventative strategy for four of the top seven deadliest chronic diseases[10]—though other factors such as family history, and socioeconomic environment play a role as well. However, many physicians lack the knowledge and skills to provide adequate nutrition counseling and education for

their patients[11,12]. Although many physicians and medical students believe nutrition is important in healthcare, they also admit to feeling ill prepared for providing these services[11]. In fact, medical schools are not required to teach nutrition (though many incorporate it into their curriculum)[12]. Schools are advised to teach 25 hours of nutrition content over the course of four years, but less than 40% actually meet this recommendation[12]. Ultimately, nutrition and nutrition counseling need to be incorporated more thoroughly into medical school curriculum. However, this process could take years to achieve and therefore a more feasible short-term alternative is needed in order to ensure patients are receiving the nutrition counseling they need to prevent and manage chronic disease.

Incorporating a supplementary nutrition course into medical students' educations can begin to mend this divide between medical school curriculum and the nutritional needs of Americans. Past studies have aimed to provide medical students nutrition education through means of lecture-style electives, online courses, and/or cooking classes[13-16]. These studies were successful in increasing nutrition competency and confidence in nutrition counseling skills but did not examine medical student attitudes towards nutrition in healthcare. The proposed study utilizes a non-conventional, multi-day interactive course (20 hours) that combines medically relevant cases-studies, with lectures, and hands-on cooking experience with a skilled chef to impact medical students' attitudes on the importance of discussing nutrition with patients. An intervention of this design has the potential instill in medical students the importance of nutrition without requiring the immediate implementation of a full medical school nutrition course.

Study Purpose

The purpose of this study was to compare the changes in the perceived importance of nutrition in the medical field in first year medical students before and after participating in a week-long interactive nutrition course. The study consisted of a 5-day, 20-hour *Selective* for first year medical students at the Mayo Clinic School of Medicine in Phoenix, Arizona. Attitudes and competencies were measured using an anonymous pre and post-study questionnaire.

Research Aims and Hypotheses

The overall aim of this feasibility study was to provide first year medical students with a brief look into medical nutrition by presenting innovative research, interactive medically relevant case studies, and chef-led healthy cooking classes in order to contribute to a growing conversation about the use of nutrition in the healthcare system. Perceived importance and relevance of nutrition was measured by comparing questionnaire responses of each participant before and after participating in the week-long course.

Research question 1: Can an interactive nutrition program increase perceived importance of nutrition in second year medical students?

H_1: Participation in a week-long disease-based interactive nutrition course and culinary demonstrations is correlated with an increase in perceived importance of nutrition in the medical field in first year medical students.

H_2: Participation in a week-long disease-based interactive nutrition course and culinary demonstrations is correlated with an increase in perceived relevance of nutrition in the medical field in first year medical students.

Definition of Terms

Healthy lifestyle behaviors: activities that attribute to life longevity and decrease the risk of chronic disease, such as a diet high in fruits and vegetables, lean protein, and whole grains, and low in added sugar and saturated fat, weekly cardiovascular exercise (150 minutes), and the omission of tobacco

Quality nutrition/healthy diet/healthy eating: a balanced diet that meets expert recommendations for high amounts of fruits and vegetables, lean protein, and whole grains, and low amounts of added sugar and saturated fat

Good Health: maintaining a balanced state of being that reduces the risk of chronic disease through activities such as consuming a diet high in fruits and vegetables, weekly cardiovascular exercise, and the omission of tobacco

Polymorphism: a variation in a genotype that can result in a different phenotypic expression of that gene

Delimitations

The population for this study was first year medical students at the Mayo Clinic School of Medicine in Phoenix, Arizona. The study site was the Arizona State University Downtown Phoenix campus. The pre- and post-study questionnaire used for the study measures included close-ended 5-point Likert scale questions in order to exclude open-ended responses. The nutrition topics covered during this feasibility study were based on the availability of expert faculty and health professionals. The cooking portion of this study was taught as cooking demonstrations on three out of five days because the cooking-class classroom was only available for two days.

Limitations

Attendance of the course associated with this study was optional for students and therefore students who chose to attend were part of a convenience sample that selected for students interested in learning about medical nutrition. This study was not adequately powered to accurately detect changes in attitudes. This feasibility study lacked a control group and therefore cannot address causality.

CHAPTER 2
REVIEW OF LITERATURE

The Toll of Chronic Disease

Chronic disease prevalence has reached an all-time high with half of all Americans diagnosed with at least one chronic condition[1,6,17] and over 40% with multiple chronic conditions[18]. Unfortunately, this epidemic affects much more than a patient's physical health. Management of chronic disease and its accompanying symptoms can cost a patient thousands of dollars[17]. According to a 2017 review published in the *American Journal of Preventive Medicine,* the annual cost for healthcare spending for an American Medicaid beneficiary with a chronic disease can range anywhere between $560 to $46,000 a year[19]. After considering this information it may come as no surprise that chronic disease constitutes 75% of all healthcare spending in the United States[1,17]. Chronic disease can also impact a patient's ability to perform simple tasks such bathing, eating, and walking, which can leave him/her dependent on professional assistance or willing family members for help[6,17]. This can interfere with daily routines[3], affect the patient's personal independence, and add stress and tension to family and marital relationships[4,6]. The treatment side effects of chronic disease can also interfere with daily living activities, as well as impact self-image, and overall negatively impact quality of life[3]. Furthermore, chronic disease has been positively associated with mental illness and symptoms of mental illness, such as depression, anxiety, and in some cases post-traumatic stress disorder[3,5,20,21]. These debilitating diseases impact every aspect of a patient's life and often those around them as well. As the prevalence of chronic disease

increases, the need for a knowledgeable healthcare team that helps patients prevent and manage these diseases, in order to improve their quality of life, has become even more important.

Fortunately, the progression of most chronic diseases can be slowed through healthy lifestyle behaviors, such as a nutritious diet, physical activity, and omission of smoking[6,16,22]. In particular, cardiovascular disease[14,23], type 2 diabetes mellitus, some types of cancer (kidney, esophagus, stomach, colorectal, breast, and endometrium), obesity, osteoporosis, and dental disease are all majorly influenced by diet quality[10,23]—the first 4 of which are in the top 7 leading causes of death in the United States[24]. The marked effects these lifestyle behaviors have on disease risk is noted in a 2002 study sponsored by the Division of Diabetes Translation at the CDC— found that participants who practiced healthy lifestyle behaviors, namely healthy eating and physical activity, showed nearly a 60% reduced incidence of type 2 diabetes[9]. In fact, poor diet has been identified as the most significant risk for disability and premature death[40]. Nutrition has been widely accepted as both a contributor to and a preventer of chronic disease. Diet interventions have been used in

Table 1. Food Components Related to a Reduction in Chronic Disease Risk

Food Components	Reduction in Disease Risk
Increased Fruit and Vegetable Consumption	Cardiovascular Disease[25,26] Cancer[25,26] Stroke[27] Type 2 Diabetes Mellitus[28] All- Cause Mortality[25]
Increased Whole Grain Consumption	Type 2 Diabetes Mellitus[27,30] Cardiovascular Disease[30,31] Hypertension and Blood Pressure[30,32]
Reduced Added Sugar	Metabolic Syndrome[33] Type 2 Diabetes Mellitus[33,34] Cardiovascular Disease[34,35] Cardiometabolic Mortality[36] Obesity[34]
Reduced Saturated and Trans Fats	Type 2 Diabetes Mellitus[29] Cardiovascular Disease[37,38] Cardiometabolic Mortality[39] Hypertension[38] Obesity[38]

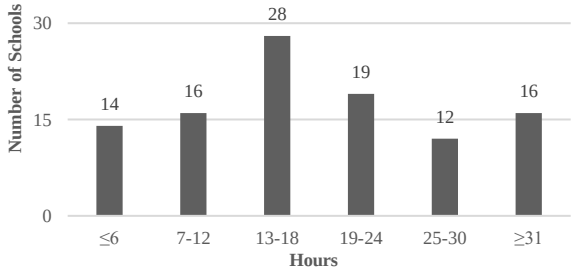
hundreds of studies that have contributed to the growing body of knowledge that supports the consumption of fruits and vegetables, and whole grain, and a reduction in added sugars, saturated and trans-fat among other diet strategies to reduce the risk of chronic disease (See Table 1). With diet playing such a large role in chronic disease and health status, it seems obvious to assume that primary care physicians would be well educated on the topic. However, this assumption would be incorrect.

Medical Student Nutrition Education

Medical students are often underprepared when it comes to counseling their patients in nutrition. According to a 2015 study published in the *Journal of Parenteral and Enteral Nutrition*, 71% of recently graduated medical students from 72 different medical school reported receiving inadequate training on nutrition counseling[41]. Graduates who reported receiving sufficient nutrition training reported an average of 4 weeks of nutrition training during medical school[42]. Interestingly, almost all students with previous nutrition training reported they had received insufficient nutrition training in medical school[42]. This suggests that students who feel they have received adequate training may be ignorant to the depth of the nutrition field. Another study published in 2008 showed only 14% of internal medicine residents reported feeling adequately trained to counsel patients in nutrition[11]. Furthermore, participating residents felt particularly unprepared to discuss portion size and food labels with their patients—two basic topics that can aid patients in chronic disease prevention. Other studies have reported similar results of residents, graduates, and physicians feeling unprepared to manage nutrition related problems[41-48]. *Kushner et al*. discusses that a lack of nutrition education can decrease a physician's nutrition self-efficacy which can ultimately affect the quantity and

quality of nutrition counseling they provide their patients[43]. These findings suggest that physicians, especially those most recently graduated from medical school, are unprepared to discuss nutrition and diet with their patients. They also suggest that medical residents and physicians may feel they are sufficiently trained in nutrition when in fact they have received very little education on the subject. Regardless of their preparedness, only 43% of primary care physicians provide guidance on diet and nutrition as part of their routine practice[49]. Contrastingly, a study published in 2018 examining 40 internal medicine program directors found that the amount of nutrition education provided to medical students was positively associated with the frequency of nutrition counseling used in practice[50]. Both studies suggest that patients are not receiving the nutrition care they require to remain healthy and disease free. They also suggest a need for a new creative approach for nutrition education in medical schools.

Figure 1. Number of Required Hours of Nutrition Education in US Medical Schools[a]



[a]Illustrates the number of nutrition education hours required for 109 US medical schools. The numbers above the bars indicate the number of schools who require the given number of hours. The recommended quantity is 25 hours. Adapted from Adams, 2010[12]

The *National Academy of Sciences* and the *Institute of Medicine* recommend that medical schools provide at least 25 hours of nutrition education for their students[12,51]. However, on average only 19 hours are spent on nutrition education with only 28% of medical schools reaching the 25 hours recommendation (Figure 1)[12,52]. Furthermore, the nutrition content is not necessarily taught in a nutrition focused course. Many schools provide nutrition education through other courses such as biochemistry or physiology. According to a 2010

study published in *Academy Medicine*, only 32 out of 109 participating accredited medical schools required a separate nutrition course[12]. Incorporating nutrition into the curriculum is ultimately at the discretion of the school, as there are no requirements for nutrition to be taught in medical schools[51].

Accreditation standards for US medical schools are determined by the Liaison Committee on Medical Education (LCME). Though incorporating nutrition into medical school curriculum can help meet the LCME requirements—specifically in preparing students to recognize wellness, determinants of health, and opportunities for health promotion and disease prevention—they do not specify that an evidence-based nutrition education be provided[12,51,52]. It should be noted that the LCME does not list specific illnesses or treatments, but rather requires medical schools to provide curricular content and clinical experience in more general subjects, such as organ systems, preventative care, and care throughout the human life cycle[52]. With this being said, nutrition remains excluded from the required curricular content. Medical school curriculum is also determined by the available faculty members' expertise. Historically, medical schools have not had faculty members who are proficient in nutrition knowledge and therefore cannot adequality and wholly teach the subject[43,48]. Furthermore, a study in the *Journal of Medical Education and Curricular Development* found that low levels of nutrition education were correlated with low perceived faculty expertise in nutrition[50]. Without teachers who have worked with nutrition in medicine, students will continue to lack the training they require counsel patients in nutrition. They will contribute to a cyclical system of inadequately educated students who become the next generation of medical school educators. Although personal experience may contribute to the student's

knowledge, not every student will have the opportunity or want to learn more about nutrition on their own.

Nutrition may also be lacking in medical school curriculum because it is only briefly covered in the US Medical Licensing Examination (USMLE)[43]. According to the exam blueprint provided by the *American Board of Internal Medicine*, nutrition makes up less than 3% of the cross-content categories[53] (Table 2). The cross-content categories appear throughout questions that focus on the primary content categories. Though the nutrition related items on the exam are evaluated by members of the Nutrition Academic Award (NAA) Program, the creators of the *Nutrition Curriculum Guide for Training Physicians*—the primary source for nutrition education in the medical field, it still does not adequality address the recommended topics detailed in the *Nutrition Curriculum Guide*[43]. It is unlikely that medical school educators will spend more than the minimal amount of time discussing a subject that takes up such a small portion of the exam. Similarly, students are unlikely to spend their limited time memorizing material that will only briefly appear on the USMLE. A brief online search revealed that study sites suggest students focus on topics that have the highest question yield on the test, which unfortunately does not include nutrition[54,55]. The official USMLE content description

Table 2. Distribution of the Primary Content Categories on the United States Medical Licensing Examination[a]

Primary Content Category	Primary Content (%)	Nutrition Content in Primary Content (%)
Dermatology	3%	<2%
Endocrinology, Diabetes, Metabolism	9%	<2%
Geriatric Syndromes	3%	<2%
Neurology	4%	<2%

[a]Details the nutrition components of the United States Medical Licensing Exam. The nutrition content is a percentage of the primary content percentages. Adapted from ABIM, 2018[53]

only lists nutrition as a potential subject to be covered in Step 1 of 3 of the exam. Furthermore, the description indicates that nutrition is an interdisciplinary subject, along with age, genetics, and cell biology among other topics, rather than a "general principle of foundational science"[56]. The USMLE is created to assess the knowledge and skills necessary to manage health and disease[56], and consequently determines which subjects are important to the medical field. Based on these assumptions, nutrition is inevitably ignored as a principle subject of healthcare.

Barriers to Incorporating Nutrition in Medicine

Poor reimbursement for nutrition services[43,51,57,58] creates an added challenge to incorporating nutrition into the medical field. Historically nutrition services, primarily nutrition counseling in an outpatient setting, have not been well covered by insurance plans, if covered at all[58]. This can leave patients in a difficult position, as good nutrition is important for continuing recovery even after patients are discharged[58]. Furthermore, good nutrition in an in-patient setting can decrease the length of time patients spend in the hospital, increase recovery speed, and decrease the risk of additional complications, such as hospital acquired infections[59,60]. However, many insurance companies have strict requirements for nutrition coverage that are often limited to people with severe diseases. For example, Medicare covers nutrition assessments, nutrition therapy services, and follow up visits, but only for qualifying members with diabetes, kidney disease, or those who have had a kidney transplant in the last 36 months[61,62]. Medicaid does not specifically cover nutrition services, though medical nutrition therapy can be covered in some states [63]. Other popular insurance companies cover nutrition services, such as medical nutrition therapy or nutrition counseling, but only for members with qualified

health conditions such as obesity, and cardiovascular disease[64-66]. Poor reimbursement for these services and strict reimbursement guidelines creates an added barrier for physicians to utilize nutrition in their practice and discourages medical students from focusing on nutritional therapies during their training.

Fortunately, there are still medical students and physicians who recognize the importance of nutrition in healthcare[11,43]. Out of 114 medical residents participating in a 2008 study, 94% agreed that it was their obligation to counsel patients on nutrition, and 77% felt a nutrition assessment should be part of routine primary care visits[11]. In another study published in 2010, almost 60% of 451 Canadian-trained family physicians felt that at least 60% of their patients could benefit from nutrition counseling[67]. These studies suggest that there are medical students and physicians who believe nutrition belongs in the medical field, regardless of their previous nutrition education or structural barriers. Medical students may also understand the clinical relevance of nutrition and have more positive attitudes towards nutrition counseling once they have undergone their clinical years[11]. This suggests that first and second year medical students who do not believe nutrition is relevant to medicine may change their attitudes after interacting with patients. This interaction can reshape a practitioner's attitudes as well as their patient's.

A physician's ability to impact their patient's nutritional health is also influenced by their own lifestyle behaviors. A study published in *Archives of Family Medicine* found that primary care practitioners who practiced healthy lifestyle behaviors themselves were significantly associated with providing health counseling and screening for their patients[68]. Another study found that medical students who participated in a health behavior intervention to improve their dietary intake, among other behaviors, showed

significant improvement in their dietary intake and were more likely to counsel patients on nutrition than students in the control group[69]. These studies suggest that encouraging medical students to practice healthy lifestyle behaviors, such as maintaining a healthy diet, may increase the amount of nutrition counseling they provide for their patients. In general, practitioners who have greater nutrition self-efficacy and who use that self-efficacy to improve their own health as well, are more likely to counsel patients in nutrition[15]. Furthermore, a health practitioner's personal lifestyle behaviors and attitudes toward nutrition can influence their patient's decisions[15,43,68,69]. Physicians should be role models for their patients, practicing the behaviors they recommend their patients perform, not only to prove they believe in the behavior, but also to experience the potential barriers and challenges that accompany behavioral changes. With the increasing prevalence of chronic disease, a more interactive approach to medicine where physicians reshape their practice based on patient's needs and personally commit themselves to understanding the health behaviors that could prevent chronic disease is becoming even more important.

Integrative Medicine

Medical students and physicians alike can improve their practice and the quality of healthcare they provide for their patients by using a more integrative approach. Most illnesses and chronic diseases are treated and prevented with a conventional medicine approach—one that uses pharmaceutical medicine, surgery, and radiation[70]. In general, conventional medicine does not involve the patient in their healthcare, but rather asks the patient to rely on a professional to cure them of their ailment. Though conventional medicine plays an important role in disease management, it is only one part of a complex system of healthcare solutions. Integrative medicine is a patient-centered approach to

medicine that focuses on the importance of healthy lifestyle behaviors, such as diet, physical activity, and the omission of smoking, using less invasive therapies and treatments when possible, and incorporating all aspects of health including mental, emotional, and spiritual health[71-73]. Integrative medicine can also be defined as a combination of complementary and alternative medicine (CAM) and conventional medicine[74]. CAM utilizes practices such as diet-based therapies, meditation, chiropractic and osteopathic medicine, and the consumption of natural products (e.g. herbal and plant medicines).

By taking a more integrative approach to medicine, in which patients are more informed about and involved in the management of their health, healthcare practitioners can both treat and manage their patients' disease and improve their patients' quality of life[3,75,76]. In a French 2018 study examining the factors impacting quality of life in cancer patients, researchers found that on days when patients were more involved in their treatment—had access to laboratory results, and/or reported that they felt their physician understood their goals—they reported a positive quality of life[3]. Patients felt they had more control over their health and that their physician had their best interest in mind. In two studies examining the effects of a six[75] and seven[76] week "Chronic Disease Self-Management Program" (CDSMP), participants with varying types of chronic disease joined a small group intervention where they were given tools to improve their health, coping, and overall wellbeing and become more involved in their healthcare. The CDSMP intervention resulted in a significant decrease in depression levels and emergency room visits, a significant improvement in fatigue and pain status and quality of life, and a significant increase in self-efficacy of disease management. As shown by

these studies, patients who participate in self-management of disease and who have a higher self-efficacy in their ability to improve their disease status tend to have an improved quality of life. Approaching disease management as a collaborative effort between the patient and the physician, where the patient is given more instruction and responsibility for their health, will ultimately benefit the health status of the patient.

Using integrative medicine as a way to incorporate non-conventional types of medicine into conventional medicine can improve patients' physical and emotional wellbeing. Data from the National Health Interview Survey published in 2011 found that participants who used CAM were more likely to rate their health as "excellent" than those who did not. Similarly, CAM users were one and a half times more likely to indicate that their health status had improved from the previous year than those solely using conventional medicine[77]. Similar findings can be seen in a 2008 study that examined the effects of a lifestyle intervention in which participants showed a decrease in psychological distress even after 5 years[78]. Integrative medicine not only affects patient attitudes, but perhaps more importantly it can cause physiological changes. In a medical review of the use of integrative medicine, researchers found that lifestyle behaviors such as yoga and meditation, consuming a low-fat vegetarian diet, and social support stopped the progression of cardiovascular disease and even reversed it in some cases[79]. The same review found that participants who used Transcendental Meditation showed a decrease in systolic and diastolic blood pressure and an improvement in their regulation of stress. Another study published in 2008, found that lifestyle changes including diet, stress management, exercise, and psychological support affected the expression of over 500 genes[80]. Participants who made these lifestyle changes had less expression of genes that

caused oxidative stress, inflammation, and contribute to cancer, and a higher expression of genes that were cancer protective.

The Cost of Integrative Medicine

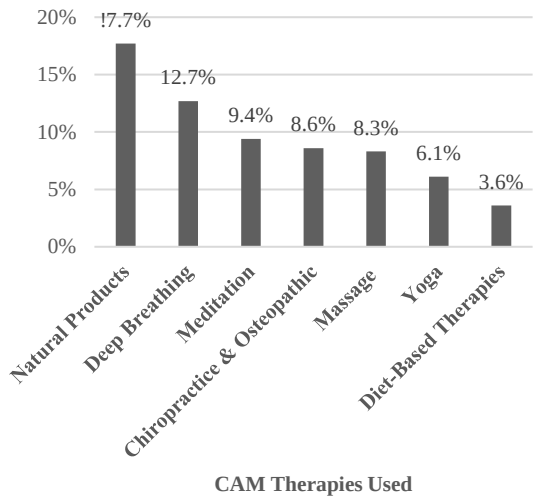
Integrative medicine not only improves a patient's well-being, but it can also reduce the financial burden of healthcare costs. According to a 2003 BlueCross medical management report, healthy lifestyle behaviors reduced the cost of heart disease related healthcare costs by 50%[79]. A 2005 study examining the cost-effectiveness of lifestyle modifications compared to the cost of the oral blood glucose controlling drug, metformin, found that lifestyle modifications could reduce health costs for type two diabetes spending by over $21,000[81]. Due to integrative medicine's prevention-based structure, healthcare spending is immediately reduced. If chronic conditions are successfully prevented, pharmaceutical, surgical, and therapeutic treatments are not necessary. By preventing illness, patients will also spend less time with their healthcare provider, which helps to reduce spending as well[79]. Furthermore, because integrative medicine utilizes non-invasive practices such as nutrition, physical activity, and meditation, which are often inexpensive or free, expensive medical procedures and treatments can be avoided. Costs due to hospital admissions can also be reduced through integrative medicine. When using Transcendental Meditation, patients had fewer in and out patient visits and hospital admissions and had lower insurance use[82].

Integrative Medicine Attitudes

With all that integrative medicine has to offer, it may not come as a surprise that many patients already use the complementary and alternative medicines often associated with integrative medicine. In fact, the 2007 National Health Interview Survey found that 4 out

of 10 adults use CAM[74]. Another study published by the *Institute of Medicine* found that 75% of patients use complementary and alternative medicines alongside conventional medicine[70] (Figure 2). Fortunately, there are also medical students who agree that integrative medicine could be a useful way to manage healthcare. A 2007 large sample survey found that 91% of 226 first- and second-year medical students agreed that CAM utilizes ideas and methods that western medicine could benefit from[83]. Eighty-five of those students agreed that knowledge of CAM will be important in their intended practice and 75% felt CAM should be part of their medical school curriculum. At one school, CAM is already part of the curriculum. The University of Arizona Center for Integrative Medicine has become the leader of integrative medicine in the medical field demonstrating that integrative medicine can be a legitimate part of medical student education. Schools such as this one with enthusiastic practitioners and students are important in furthering the conversation for learning more about and accepting CAM as part of medical practice.

Figure 2. 7 Most Common CAM[a] Therapies Used Among Adults in 2007[b]



[a]Complementary and alternative medicines (CAM)
[b]Adapted from NCCINCHS, 2008[74]

Food as Medicine

For centuries, food was used as a source of medicine and healing, both preventatively and in treatment. People have looked to plants to cure life's ailments and to alleviate pain. However, modern medicine has become more advanced—providing

patients with more concentrated and sophisticated versions of the natural molecules and components that heal human bodies. Fortunately, people are now healed faster and achieve more immediate relief from their symptoms thanks to synthetic drugs. With this being said, plants can still be used to help maintain good health alongside modern medicine, both through their more medicinal uses, and more importantly, as the staple of a more plant-based diet.

Table 3. Recommended Daily Servings of Individual Food Groups of a Plant-Based Diet[a]

Food Group	Recommended servings per day
Vegetables, all types including starchy vegetables	Ad libitum, include a variety of colors
Fruits, all types	2-4 servings (1 serving =1 medium pieces or ½ cup)
Whole grains (e.g. brown rice, whole wheat, quinoa, oats)	6-11 servings (1 serving = ½ cup cooked or 1 slice whole grain bread)
Legumes (beans, lentils, peas, soy foods)	2-3 servings (1 serving = ½ cup cooked)
Leafy green vegetables (e.g. broccoli, kale, spinach)	At least 2-3 servings (1 serving = 1 cup raw or ½ cup cooked
Nuts (e.g. almonds, pecans, walnuts)	1-2 ounces
Seeds (e.g. chia, flax, hemp seeds)	1-3 tablespoons
Fortified plant milks (e.g. almond, soy, rice)	Optional, 2-3 cups

[a]Adapted from Hever, 2017[84]

A balanced plant-based diet consists of legumes, whole grains, nuts, and seeds, with half of each meal consisting of fruits and vegetables[84,85] (Table 3). This diet ensures a sufficient intake of fiber, potassium, magnesium, folate, iron, vitamin A and vitamin C, among other nutrients, which help with metabolism and healing, reduce oxidative stress, and generally promotes healthy bodily functions[85]. Along with these nutritional properties, the amino acid content of plant proteins[86], the phytochemical content of plant foods, including carotenoids, flavonoids, and glucosinolates, and plant interactions with the gut microbiome[86,87] are a few of the widely accepted reasons of how

plant-based diets can improve disease state[86]. With this being said, the exact properties of plant-based diets that lead to healthier outcomes are difficult to isolate, but it is likely a combination of many different components that yield the greatest results in improving health.

Plant Based Diets

Numerous studies have showed the positive impacts of incorporating a healthy plant-based diet into everyday lifestyle behaviors[78,79,88]. A 2018 systematic review found that a plant-based diet, with an emphasis on nuts, plant protein, viscous fiber, and plant sterols, significantly reduced risk factors for cardiovascular disease in 7 trials[89]. In particular, it reduced LDL-cholesterol, triglycerides, systolic and diastolic blood pressure, and c-reactive protein, among other factors. Another systematic review published in 2016, examined the effects of a plant-based diet on obesity-related inflammation[90]. This review found that when people with obesity consumed a plant-based diet their inflammatory profiles, including C-reactive protein, interleukin-6, and soluble intercellular adhesion molecule 1, were significantly reduced, which consequently reduced their risk for developing a secondary chronic disease. Adherence to a mostly plant-based diet has also been associated with a decreased risk of recurrent cancer in cancer survivors[91], a decreased risk of metabolic disease, and type two diabetes mellitus[23,29,88], and a decreased risk for mortality[91].

Another popular diet described in the literature is the Mediterranean diet. This diet, which is still mostly plant-based, also emphasizes the consumption of olive oil and fish, or more specifically omega-3 fatty acids[92]. The Mediterranean diet has been used to decrease the risk of cardiovascular disease, decrease the risk of a second myocardial

infarction and decrease mortality rates due to myocardial infarction[92], in part because of its low saturated fat and high omega-3 fatty acid content. Interestingly, this diet is not low in fat, despite triglyceride and cholesterol levels being a major concern for cardiovascular disease risk[93]. The Mediterranean diet can also be used to treat individuals with metabolic syndrome. A 2004 randomized control trial found that after two years of consuming a Mediterranean diet, only 44% of participants still had symptoms of metabolic syndrome, compared to 87% in the control group [94]. The Mediterranean diet has also been associated with a decreased risk for osteoporosis. A 2017 study based in Naples, Italy found that individuals who consumed a Mediterranean diet, defined as high consumption of olive oil, fruits, vegetables, legumes, and fish and low consumption of red meat, had a higher bone mineral density than those who did not [95].

The Anti-Inflammatory Diet

Another dietary intervention described in the literature is the anti-inflammatory diet. The components of this diet vary between interventions, but its overall goal is to downregulate pro-inflammatory molecules[96]. This can be achieved through the consumption of diet that is low in omega-6 fatty acid and saturated fat, and high in omega-3 fatty acids, fermentable fiber, and non-starchy vegetables[97]. These foods reduce inflammation by maintaining a high omega-3 to omega-6 fatty acid ratio, stabilizing insulin levels, and maintaining a healthy gut microbiota[96,97]. This diet also encourages healthy lifestyle behaviors such as the omission of smoking, reduced alcohol consumption, and regular physical activity [96].

The anti-inflammatory diet can be used to manage autoimmune diseases such as multiple sclerosis[96], inflammatory bowel disease, and rheumatoid arthritis[8]. A pilot study

published in 2016 looked at the relationship between the inflammatory status and wellness of participants with multiple sclerosis and the consumption of a semi-vegetarian diet with vitamin D shots and dietary supplementation of fish oil, lipoic acid, and omega-3 polyunsaturated fatty acids, resveratrol and a multivitamin[98]. The study found that although there were no significant changes neurological signs after 6 months, the inflammatory marker, serum gelatinase, had decreased by almost 60%. Another study examining participants with multiple sclerosis, looked at the effects of a probiotics on inflammatory markers and insulin resistance[99]. This study found that after three months of probiotic capsule supplementation, participants not only had reductions in inflammatory markers and insulin resistance, but they also showed an improvement in disability status and mental health measures. Probiotics have also been used to reduce inflammation in patients with inflammatory bowel disease. A 2017 meta-analysis analyzed the effects of probiotic in a variety of forms including capsules, yogurt, sauerkraut, kimchi, and kefir on inflammatory bowel disease[87]. The analysis revealed that probiotics significantly improved ulcerative colitis symptoms in 18 different studies.

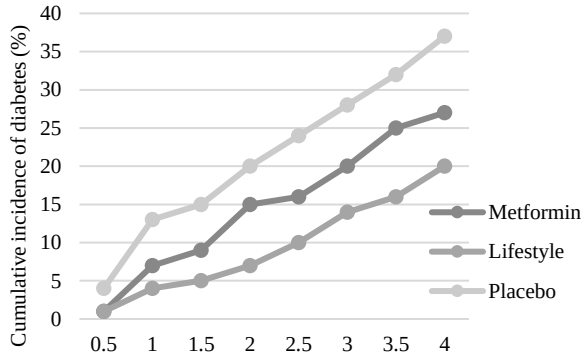
Anti-inflammatory diets can also be used to reduce the risk of chronic disease. Although inflammation is an important part of the immune system that assists in communicating tissue damage and infection, chronic low-level inflammation can induce chronic disease[97]. After years of this low-level inflammation persisting, repertory mechanisms become exhausted and tissue and organs are damaged[97]. Because of these mechanisms, anti-inflammatory foods or diets can be useful in reducing the risk of inflammatory diseases such as obesity, cardiovascular disease, and type two diabetes. The

high omega-3 fatty acid to omega-6 fatty acid ratio in many vegetarian and Mediterranean diets likely contribute to these diets' chronic disease reduction qualities.

Dieting and Disease

When patients adhere to high quality diets, the results can be just as successful if not better than conventional methods. A 2005 study by *Jenkins et al.* examining the effects of a diet high in plant sterols on hyperlipidemic participants found that participants' LDL-cholesterol levels were not significantly different during their diet weeks than during the weeks they took statin medication[100]. In other words, the plant sterol diet, which consisted of mostly soy products, almonds, and plants with viscous fibers, decreased LDL-cholesterol levels at a statistically similar level as a cholesterol lowering medication.

Figure 3. Cumulative Incidence of Diabetes[a] Based on Study Group[b]



[a]Diabetes was diagnosed using the American Diabetes Association criteria. The incidence of these groups differed significantly.
[b]Adapted from Knowler, 2002[9]

Furthermore, although it was not statistically significant, participants had their lowest LDL levels during the diet week. In a 2002 study sponsored by the Diabetes Prevention Program, researchers examined the effects of a healthy lifestyle intervention on type two diabetes incidence in at risk individuals[9]. The study found that participants who received the lifestyle intervention, which included a healthy low-calorie low-fat diet, and 150 minutes weekly of moderate intensity physical activity, had significantly lower incidents of type two diabetes than participants receiving Metformin, the current type two diabetes prevention medication, or the placebo (Figure 3). Participants showed incidence rates

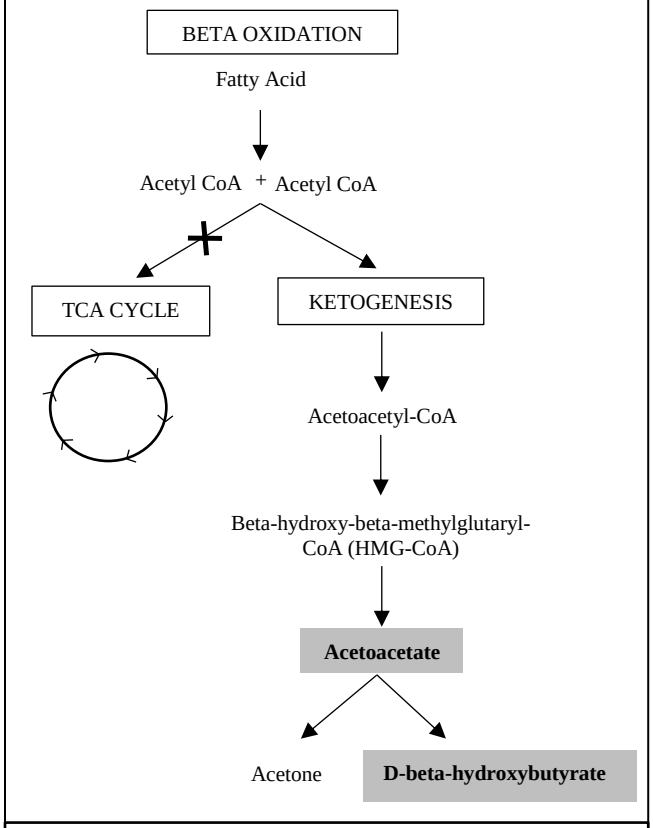
consistent with these results over the course of four years. These studies show that nutrition is a viable alternative to pharmaceutical interventions for preventing and managing chronic disease.

It is possible that nutrition can be even be used to manage more metabolically complicated diseases, such as brain cancer. Glioma cells, brain and spinal cord tumor cells, spread quickly and are difficult to treat. Radiation and chemotherapy can kill most of the malignant cells however any remaining cells rapidly regrow, and complete surgical removal is difficult to do while maintaining the integrity of remaining brain cells[101]. Cancer cells have increased rates of glycolysis that allow them to quickly produce energy and therefore grow. Unfortunately, patients diagnosed with a glioblastoma multiforme, the most aggressive glioma brain tumor, have a life expectancy of one to one and half years[101]. However, the metabolic dysfunction in cancerous cells that results in increased rates of glycolysis and therefore faster growth does come with a few caveats—one of them being that cancerous cells cannot use ketones as an energy source[101,102]. By blocking the glycolytic pathway in cancerous cells, or limiting the intake of glucose, the cells can potentially be slowed or stopped from spreading[103-105]. This can be achieved through the ketogenic diet. Not only does this diet reduce blood glucose, but some studies have suggested that ketone bodies may be toxic to cancer cells, can alter cancer cell gene expression[101,106], and have neuroprotective properties that increase ATP levels in healthy cells[102].

The ketogenic diet is a high fat, low carbohydrate and low protein diet. The high intake of fat and low intake of carbohydrates (glucose) results in a down regulation of glycolysis, the breakdown of glucose, and glycogenolysis, the breakdown of stored

carbohydrates called glycogen, and an upregulation of ketone body production (Figure 4). Fatty acids undergo beta oxidation in the liver and produce two acetyl coA. When enough glucose is available the acetyl coA will enter the TCA cycle to help produce most of the ATP in cellular respiration[107]. During ketogenesis, where there is not enough glucose, these acetyl coAs enter the ketogenic pathway and produce acetoacetate and beta-hydroxybutyrate—ketone bodies. Ketone bodies can then be used as energy sources in all non-hepatic cells.

Figure 4. Ketone Body Production from Fatty Acids[a]



[a]Metabolic processes are capitalized and in a box and ketone bodies are bolded and in grey.

Although an experimental study has yet to be published, numerous case studies have shown encouraging results in using the ketogenic diet to treat malignant brain tumors. A case study published in 2010 reported a 65-year-old patient with glioblastoma multiforme who received the ketogenic diet alongside conventional medical treatment for the cancer. The restricted ketogenic diet provided a 4:1 ratio of fat to protein and carbohydrates and 600 calories per day. The study reported that after two months of treatment and the ketogenic diet no brain tumor tissue was detected. After this point, the patient no longer followed the strict caloric requirement of the diet and after 10 weeks an

MRI scan revealed tumor recurrence[108]. The recurrence of the tumor makes a compelling argument that the restricted ketogenic diet prevented the growth of the glioblastoma multiforme. A pilot study published in 2011 showed similar results. The study included 12 individuals with advanced malignant brain tumors who had already tried all other treatment options. Of the 12, five completed all three months of the ketogenic diet treatment and had stable disease states. The other five living participants who did not complete the three months all had a progression in their disease[109]. Although this study does not prove that the ketogenic diet prevented the progression of brain cancer, it suggests that ketone bodies could play an important role in managing brain cancer.

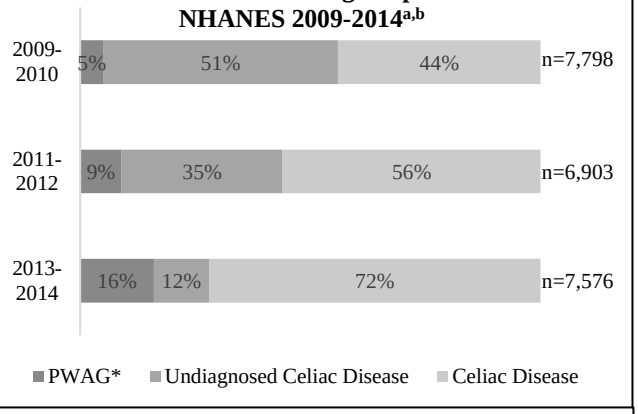
Popular Diets

Aside from weight loss, diets are primarily used to try and improve health. They can help reduce or eliminate nutrients with adverse effects and increase nutrients that are beneficial. Dieting is particularly beneficial for people whose bodies cannot tolerate or process certain nutrients. A diet can make it easier to eat foods that are more compatible with their biochemistry. For example, an individual diagnosed with celiac disease, an autoimmune disease that causes damage to the small intestine when gluten is consumed, might eat a diet that does not include gluten containing foods such as wheat, barley, and rye[110,111]. By consuming a diet without gluten, they can improve the integrity of their small intestine, which allows them to absorb more nutrients than during their autoimmune reaction, and as a result will reduce their risk of nutrient deficiencies. For this person, a gluten-free diet allows them to live a healthier life[111,112]. However, many people without a food intolerance still use diets to live a healthier lifestyle and often

choose diets without knowing the legitimate benefits and risk of the diet—such as with the gluten free diet.

The gluten free diet began gaining interest by American popular culture after the publication of a large population study, with more than 13,000 participants, in 2003[113] (see Figure 5). This study suggested that almost 1% of the American population has celiac disease, with an even higher prevalence (about 4.5%) in individuals with family members who have celiac disease. Since then, various studies have examined if the gluten-free diet could be used to help manage other conditions such as autism spectrum disorder, psoriasis, rheumatoid arthritis, and irritable bowel syndrome[114]. Individuals without a celiac disease diagnosis also began experimenting with the gluten-free diet at home[115].

Figure 5. Percent of Americans on the Gluten-Free Diet And Their Dieting Purpose Based on NHANES 2009-2014[a,b]



[a]Sample size of each year is indicated on the right side of the bar.
[b]Adapted from Choung, 2016
*People Without Celiac Disease Avoiding Gluten

While the popularity of the diet did benefit those with celiac disease as more gluten-free foods became available and more products advertised the gluten-free seal[114,116], it has also led to many misconceptions about the gluten free diets. Perhaps the biggest misconception is that gluten-free foods are healthier than gluten-containing foods[117]. Many people choose to eat a gluten-free diet because they believe it will help them lose weight and improve their overall health[116-118], despite the fact that the gluten-free diet is still only indicated for those with celiac disease or gluten-sensitivities[111] and

that there is no concrete evidence to support that the gluten-free diet aids with weight loss or is a healthier alternative to a gluten-containing diet[111,114,116]. In fact, there is more evidence to support that a gluten-free diet increases BMI because it helps increase overall nutrient absorption in individuals with celiac disease[111,116]. Furthermore, consuming a gluten-free diet comes with additional nutritional challenges that people do not always realize. The biggest challenge being that the gluten-free diet tends to be low in fiber, B vitamins, folate, iron, zinc, magnesium, and calcium[112,119-121].

The gluten-free diet is not the only misunderstood diet. The vegan diet is a popular diet that excludes all animal products for ethical, religious, environmental, and/or health related reasons. Because this diet is plant-based, the word "vegan" has become synonymous with "healthy" in popular culture. However, this is not true. Just like any balanced diet, the vegan diet contains some foods that should be eaten often, such as foods high in vitamins, minerals, and fiber, and other foods that should be eaten less often, such as foods high in simple carbohydrates or saturated fats. Additionally, because the vegan diet eliminates an entire food group, animal products, there is the potential for some health-related problems. A significant issue is that the vegan diet does not contain vitamin B12 because vitamin B12 is almost exclusively found in animal sources[122]. Furthermore, the vegan diet tends to be low in calcium and bioavailable iron[123]. Pairing two diets, such as the gluten-free diet and vegan diet can further restricts the types of food an individual can eat and therefore can increase the risk for nutritional inadequacies and deficiencies. Without a good understanding of the nutrients being excluded from their diet, dieting individuals might be putting themselves at risk for adverse health effects. Although diets can be used as a way to make people healthier, it is important that

people have a basic understanding of nutrition and metabolism and the risks that a new diet may pose to their health.

Although the expectations of many popular diets may be misguided (i.e. fast way to lose weight, detoxification), the popularity of dieting does show that people are interested in becoming healthier and that they want to do so through nutrition. Even with the risks and misconceptions, dieting ultimately gives people the opportunity to have more control over their health. With the increasing popularity of diets and nutrition, it is even more important that health professionals are familiar with nutrition, encourage their patients to seek reliable sources before making significant alterations to their diet, and help debunk false dieting claims, so that people can begin making dietary changes in a healthy way.

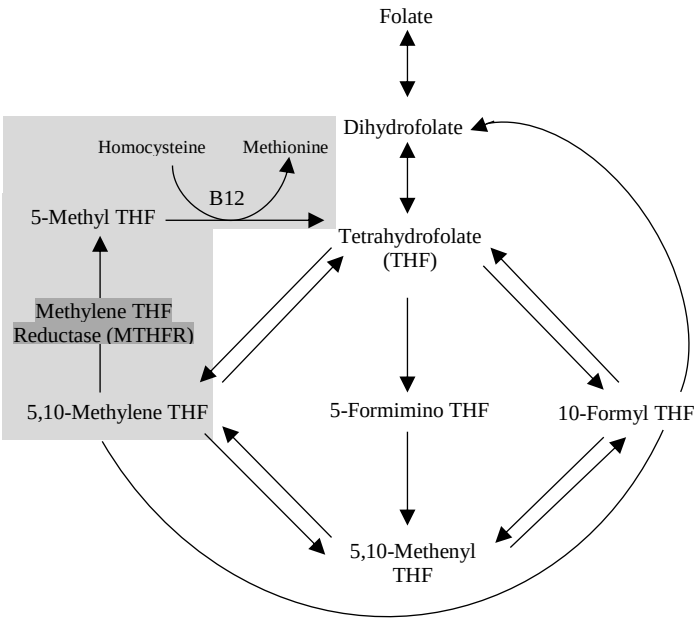
MTHFR Polymorphism Diet

Fortunately, there are some diets that can benefit a large majority of the population that have little risk. For example, a plant-centered diet, as explained previously, is associated with multiple positive health outcomes and is essentially risk free because it is not restrictive and does not eliminate any food groups. The Mediterranean diet could benefit a large majority of the population for similar reasons. Another lesser known diet that has the potential to improve people's health without risking nutrient deficiencies is the MTHFR or, Methylene tetrahydrofolate reductase, polymorphism diet. This diet targets the 20% of the population with a MTHFR polymorphism by providing them with an abundance of folate and vitamin B12[124].

MTHFR is responsible for converting 5,10 methylene THF to 5-methyl THF, the primary circulating form of folate, which is then used to methylate homocysteine to

methionine (Figure 6). Methionine plays an important role in metabolism, oxidative stress, and as a substrate for other amino acids such as cysteine, creatine, and carnitine[125]. When a MTHFR polymorphism is present, the MTHFR enzyme activity works at about 30% the normal rate[126]. Because of this, folate becomes trapped as 5,10 methylene THF, homocysteine cannot be converted to methionine, and homocysteine levels rise[127]. Furthermore, individuals with the MTHFR polymorphism are at an increased risk for cardiovascular disease, acute lymphocytic leukemia, and neural tube defects[124,126]. Folate insufficiency, which can be a result of the MTHFR polymorphism, increases the risk for colorectal cancer, interrupts the process of DNA repairing mechanisms, and can cause macrocytic anemia[128,129]. Vitamin B12 is also important in this portion of the folate cycle, as it transfers the methyl group from 5-methyl THF to homocysteine to produce both THF and methionine. A deficiency of vitamin B12 can also raise homocysteine levels, similar to the presence of the MTHFR polymorphism. This can lead to a variety of health problems as high levels of homocysteine can increase oxidative stress and are associated with an increased risk for

Figure 6. Folate Cycle with an Emphasis on Methylene THF Reductase[a]



[a]When the MTHFR (marked in dark grey) polymorphism is present, folate becomes stuck as 5,10-methylene THF. The light grey portion highlights the conversion of 5-methyl THF to THF and homocysteine to methionine. When there is a B12 deficiency homocysteine cannot become methionine and 5-methyl THF cannot become THF. Note the metabolites in the double arrow diamond can be converted in either direction.

cardiovascular disease, renal disease and gastrointestinal disorders[130-133]. Therefore, managing a MTHFR polymorphism and serum B12 status is important for maintaining long-term health.

The MTHFR diet focuses on high amounts of folate-containing foods such as cooked beans, lentils, spinach, asparagus, edamame, and liver[134].Many green cruciferous vegetables also contain folate and some grains are enriched with it as well. Because folate is water soluble and therefore not stored in the body, it is important that folate is consumed on a consistent basis[134]. The exact micrograms of folate that should be consumed per day to decrease the risk of morbidity with the MTHFR polymorphism is still unclear[128]. With this being said, a meta-analysis published in 2012 categorized "low" folate intake as about 115 to 400 mcg/day and "high" folate intake as 320 to 485mcg/day[128]. High folate intake was associated with a reduced risk of some of the comorbidities associated with the MTHFR polymorphism, especially colorectal cancer. The current daily recommended intake for folate, 400mcg for males and females 14 years and older, aligns well with the findings of this review[129,134]. Another study published in 2001 that examined the effects of folic acid on genomic stability suggests that 700mcg/day is a sufficient quantity of folate to minimize abnormalities in DNA synthesis as a result of metabolic defects[135], such as with the MTHFR polymorphism. Regardless, consuming at least the recommended daily intake of folate is appropriate whether or not there is a MTHFR polymorphism present.

Consuming adequate amounts of vitamin B12 is also important for someone with the MTHFR polymorphism (Table 4). Both a folate and vitamin B12 deficiency can lead

to macrocytic anemia, which can make it difficult to identify the vitamin that is causing the anemia—especially when there is a MTHFR polymorphism[134]. This issue can be easily avoided by consuming vitamin B12 on a regular basis. Some foods containing vitamin B12 include clams, liver, fish, beef, and milk[136]. The recommended dietary allowance for B12 in adults who are not pregnant, or lactating is 2.4 mcg, which is about the equivalent of a 3 ounce can of tuna fish[136]. Because the MTHFR polymorphism and vitamin B12 deficiency are so closely connected in the folate cycle and with macrocytic anemia it is important to address the intake of both folate and B12 when a MTHFR polymorphism is present.

Table 4. Recommended Dietary Allowance of Vitamin B12 by Age[a,b]

Age	Vitamin B12 (mcg)
1-3 years	0.9 mcg
4-8 years	1.2 mcg
9-13 years	1.8 mcg
14+ years	2.4 mcg

[a]Values are indicated for males and females who are not pregnant or lactating.
[b]Adapted from NIH, 2018[136]

Most of the foods that naturally contain folate are plants that also contain high amounts of other vitamins and minerals. This means that a diet naturally high in folate, rather than a diet with folic acid supplementation, is also a diet high in plant foods. Because folate and vitamin B12 are water soluble, they are safe to consume in large amounts if they come from natural sources[129,136]. This means that an MTHFR polymorphism diet could not only benefit individuals with and without the polymorphism, but it is essentially risk free in regard to folate and vitamin B12, if these vitamins come from whole food sources.

Food Components

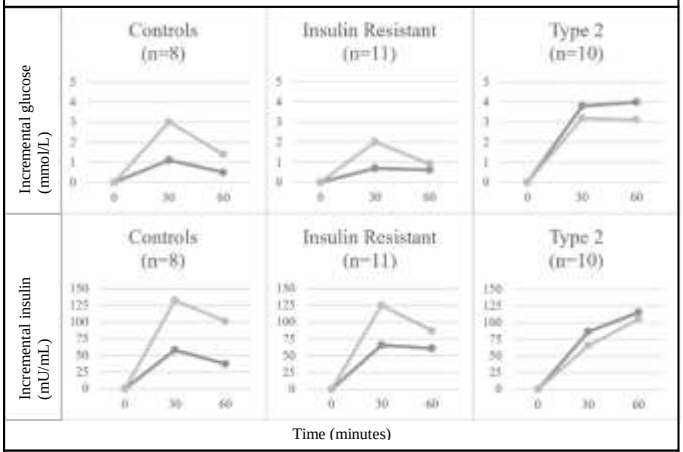
Diets typically provide people with a list of foods that they should try to eat more of and foods they should try to eat less of. However, it is not always necessary to change

an entire diet to see health benefits. Of course, it is the individual foods within the diet that actually produce changes in health. Although it is still important to consume a balanced diet of health-supporting foods, the individual foods should not be overlooked for the powerful benefits they may provide.

Vinegar has long been used for its medicinal properties. In the past, it was used as an antimicrobial, to cure coughs and stomachaches, and to help regulate blood sugar in diabetics[137]. Although many of its original uses have been disproven or do not work as well modern alternatives, using vinegar to manage blood glucose has carried forth as a legitimate remedy. In 1995, an article was published in the *European Journal of Clinical Nutrition* that demonstrated that vinegar, administered as 20mL of white vinegar in salad dressing, decreased the participants' glucose response[138]. In half of the testing, the healthy participants were asked to consume 50g of carbohydrates, as white bread, after eating their vinegar-dressed salad. Even with the addition of the white bread, participants' blood glucose response decreased by almost 32%. This study not only demonstrated that vinegar can impact blood glucose after a glucose containing meal, but also that only a small quantity of vinegar may be necessary to see these effects—less than 1 ½ tablespoons in this case. In another study published in 2004, investigators examined the effects of vinegar on participants with insulin sensitivity and type 2 diabetes[139] (Figure 7). Participants were asked to fast before arriving, consume a mixed drink containing 20g of apple cider vinegar or a placebo, then after 2 minutes eat 87g of carbohydrates as a white bagel with butter and orange juice. The following week the cross-over trial began. The study found that in insulin-resistant participants the apple cider vinegar increased whole-

body insulin sensitivity by about 34% an hour after the meal and significantly reduced postprandial glucose fluxes. In diabetics participants, the vinegar increased insulin sensitivity by about 19% and decreased postprandial glucose fluxes, though it was not significant. Although more research still needs to be done, this study provides compelling evidence that vinegar may be used as a way to assist in managing insulin response and blood glucose.

Figure 7. Comparison of Incremental Glucose and Insulin Levels of Study Groups[a] After Consuming Vinegar or Placebo Drink[b,c]



[a]Study groups included a control group, participants who were insulin resistant, and participants with type 2 diabetes.
[b]Light grey line indicates vinegar was consumed and dark grey line indicates the placebo was consumed. Blood glucose and insulin were taken before consumption (0 minutes), 30 and 60 minutes after consumption of the vinegar or placebo drink.
[c]Adapted from Johnston, 2004[139]

Conclusion

Although alternatives such as these food components should not be used in place of seeking medical attention, they can be used as a complement modern care. Using food components such as vinegar or turmeric could provide a less invasive, safer and sometimes less expensive way to help manage or prevent chronic conditions. With this being said, it is important that health professionals remain open to what food may offer to people's health and help promote the continuation of research on food. Building on this research may reveal more diverse ways to help people stay healthy and "natural remedies", such as the ones explained above, may help manage and prevent chronic conditions making good health more easily accessible to the everyday person. Thus, it is

important to educate health professionals, especially future physicians who are likely to be the primary source of health-related knowledge for the general public, on the value of nutrition in health maintenance. Putting an emphasis on nutrition education in medical students will therefore not only impact their patients but will impact the medical world.

CHAPTER 3

METHODS

Study Design

The sample population was a subset of first year medical students attending the Mayo Clinic School of Medicine (MCSM) in Phoenix, Arizona, in spring 2019. Any student who volunteered to attend the five-day "Food as Medicine" course Selective was eligible to participate. All participants provided written consent; however, if students chose not to participate in the study, they could still attend the course without any restrictions. Participants were recruited during an "open pitch" lunch at MCSM. The principle researcher, Dr. Carol Johnston presented the "Food as Medicine" course associated with this study as an evidence based interactive lecture and cooking skills Selective. Students were also given a flyer with a detailed outline of the course (see Appendix B). Students chose the "Selective" they wished to attend, since multiple Selectives were available in the same time slot. The study received approval by the Arizona State University Institutional Review Board (see Appendix A).

This feasibility study was conducted as a single group non-experiment. There was no control group, and participants acted as their own control in all analyses. The study consisted of a 5-day, 20-hour, intervention with a pre and post study questionnaire to measure nutrition attitudes. Days began with approximately one hour of interactive case-study work, which was worked on independently and then discussed as a class. This was followed by an hour-long lecture detailing a chronic disease and its unique nutrition intervention, which was determined by the expertise of the lecturer, followed by a half hour discussion of diets and meals relevant to the intervention. Students then spent an

hour either watching and sampling a cooking demonstration related to the day's topic or cooking the food themselves following the direction of an experienced chef. For the last thirty minutes, case studies were revisited in the context of the lecture information and participants were debriefed. Some of the primary discussion points visited throughout the course included how to discuss nutrition with your patient, how to encourage healthy eating in your patients, and how to determine which patients would benefit from a specialized diet or nutrition counseling. A more detailed outline of the study flow, including topics covered during the lectures, case-studies, and recipes used, can be found in Appendices C-F. The length and design of the study was meant to fulfill the MCSM requirements for a selective course and the Accreditation Council for Graduate Medical Education's requirements for a medical school course.

Sample Size

Sample size was determined using peer reviewed literature that examined positive changes in food, nutrition or health behaviors after an intervention[140-143]. These studies were similar to ours in their study measures and therefore contributed to our sample size. The sample size of 135 (68/group) was determined by averaging the calculated n per group of the reference studies (Appendix G). Seventy participants were required to achieve a power of 80% and an alpha level 0.05 according to the sample size calculator provided by *Schoenfeld*[144]. However, the sample used in the study did not meet the sample size requirements because participation was limited to the number of students attending the "Food is Medicine" Selective. Since the students who chose to attend our Selective were interested in learning nutrition, the sample was not truly representative of the sample population—first year medical students at MCSM. However, demographic

information was still recorded and analyzed to determine generalizability to second year medical students at MCSM and to second year American medical students.

Measures

Data was collected March 11-15, 2019 at Arizona State University Downtown Phoenix campus. At the start of the study, before any nutrition content was discussed, participants completed an anonymous pre-study questionnaire to measure their attitudes towards nutrition in the medical field (See Appendix H). The same anonymous questionnaire was administered during the last class to compare to the pre-study questionnaire. Questions for the questionnaire were developed using questions from validated surveys in the literature[11,41,67,83,145-149]. Question were modified slightly to adjust for our specific study measures and responded population. Data from the questionnaires were matched based on a blinded identifier; participants created a unique unidentifiable number using the last two digits of their address, last two digits of their phone number, and two-digit birth day. Because the study was not a true experiment, the pre and post-study questionnaires were analyzed to reveal the relationship between participants' perceived importance of nutrition in the medical field before the intervention and after the intervention. Participants were not asked to limit any activities outside of the study.

The pre and post-study questionnaire was first tested on pre-med students attending Barrett, The Honors College at Arizona State University. The questionnaire was administered to these students through the online survey forum, Qualtrics (See Appendix I). The purpose of the pre-med student questionnaire was to provide an opportunity to alter the questionnaire, so questions were clearer to the participants, based

on the pre-med student feedback. The responses also provided additional data to evaluate potential future physicians' attitudes towards nutrition.

Statistical Analyses

All data was evaluated using IBM SPSS version 24. Data was determined to be non-normal using the Shapiro-Wilk test and remained non-normal after transformation. Data was analyzed using the Wilcoxon Signed Rank test using an alpha level of 0.05. Data are presented as a mean ± standard deviation. Study measures were determined using a 5-point Likert scale, therefore '5' indicates the participants strongly agreed with the statements and '1' indicates the participants strongly disagreed with the statements. The results only include responses that the participants chose and therefore do not include responses that had a 0% response. Additionally, participants' descriptives and the pre-med student responses are presented as mean ± standard deviation and as response frequencies.

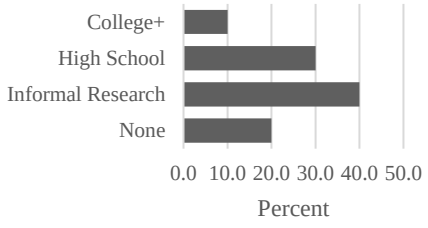
CHAPTER 4

RESULTS

Descriptives

A total of 10 medical students consented to participate in this study. The participants in this study included 4 men and 6 women. This gender distribution was comparable to the current and previous medical school class at MCSM, which were 26 men and 23 females, and 26 men and 24 women respectively. The men had a mean BMI of 23.6kg/m^2 (±1.3) and all were below 25kg/m^2. The women had a mean BMI of 25.7kg/m^2 (±4.5), and 4 were above 25kg/m^2. All of the participants reported that they had never provided nutrition counseling or education so far in their educational or professional career. When asked about their previous nutrition education, 10% responded that they received nutrition education during their undergraduate degree, 30% received nutrition education during high school, 40% learned about nutrition through informal research due to personal interest, and 20% did not receive any nutrition education (Figure 8). When asked how many hours of nutrition education they had received in medical school, 9 participants answered 0 hours, and 1 participant answered 1-5 hours.

Figure 8. Previous Nutrition Education[a]

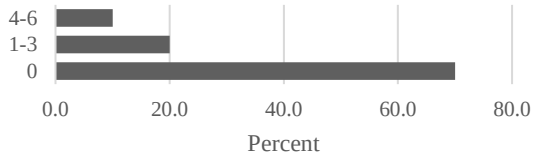


[a]Participants indicated which types of nutrition education they received prior to attending medical school.

Ten percent of participants rated their dietary knowledge as “very good”, 30% rated it as “good”, 40% rated it as “neither good nor poor”, and 20% rated it as “poor” (Figure 9). Participants were also asked how important it was for them to cook meals at

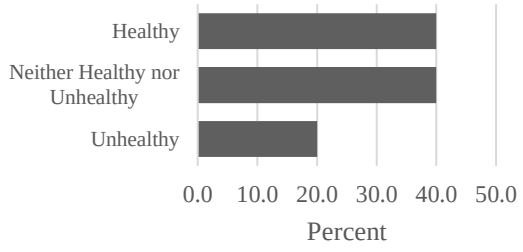
home with their family when they were a child. Twenty percent said it was very important, 50% said it was important, 20% said it was neither important nor unimportant, and 10% said it was unimportant (Figure 10). Only 3 students indicated that they had previously attended a cooking class. When asked how many times a week they ate out, 20% of participants said 7 or more meals, 20% said 4-6 meals, and 60% said 1-3 meals (Figure 11). When students were asked how many times per week they cook their own meals, 40% said 7 or more meals, 30% said 4-6 meals, 20% said 1-3 meals, and 10% said 0 meals (Figure 12). Ten percent of participants indicated that they cooked meals with another person 4-6 times per week, 20% cooked meals with another person 1-3 times per week, and 70% indicated they did not cook meals with another person (Figure 13).

Figure 13. Number of Times per Week Participants Cook with Other People[a]



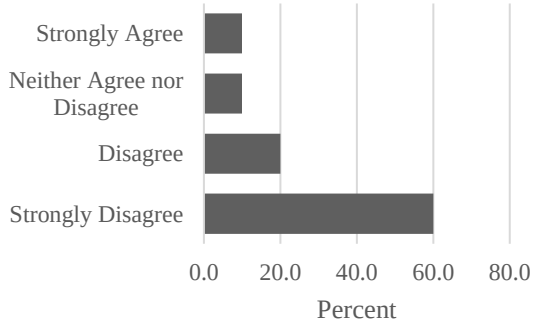
[a]Participants indicated how many times per week they cooked with other people.

Figure 14. Participants Rate Their Diet Quality[a]



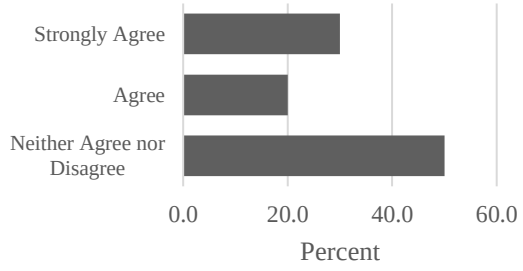
[a]Participants rated their diet quality.

Figure 15. I Can Adequately Provide Nutrition Counseling[a]



[a]Participants indicate how much they agree with the statement: I can adequately provide nutrition counseling.

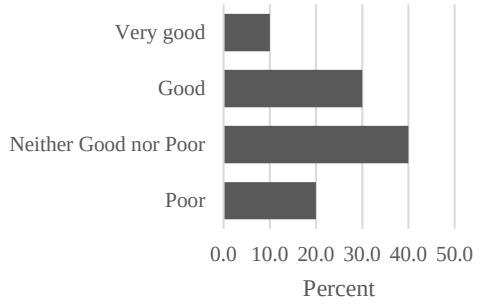
Figure 16. I Plan to Discuss Cooking At-Home Meals with My Future Patients[a]



[a]Participants indicate how much they agree with the statement: I plan to discuss cooking at-home meals with my future patients.

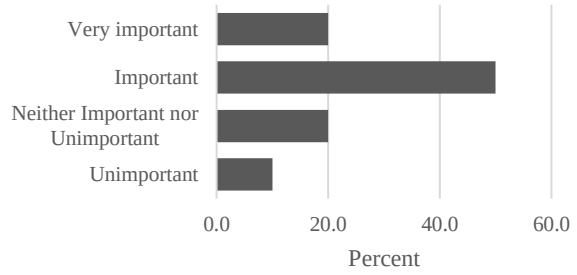
Participants also rated their diet quality. Forty percent said their diet was healthy, 40% said their diet was neither healthy nor unhealthy and 20% said their diet was unhealthy (Figure 14). Participants were asked if they agreed that medical school had adequately trained them in nutrition and adequately trained them in nutrition counseling. For both questions, 6 participants responded "disagree" and 4 participants responded, "strongly disagree". When participants were asked how much they agreed with the following statement, "I can adequately provide nutrition counseling", 10% said they strongly agreed, 10% said they neither agreed nor disagreed, 20% said they disagreed, and 60% said they strongly disagreed (Figure 15). The average response to this question on the pre-study questionnaire was 1.8±(0.4) and 2.3±(0.3) on the post-study questionnaire Finally, when participants were asked how much they agreed with the following

Figure 9. Participant Ratings of Dietary Knowledge[a]



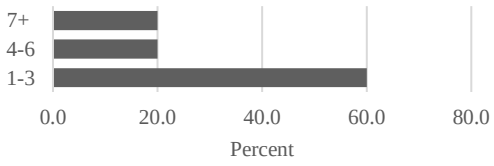
[a]Participants rated their dietary knowledge.

Figure 10. Importance of Cooking with Family[a]



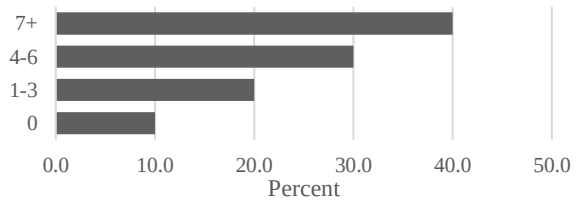
[a]Participants indicated how important it was for them to cook meals at home with their family when they were a child.

Figure 11. Number of Times per Week Participants Eat Out[a]



[a]The Y-axis indicates hours per week.

Figure 12. Number of Times per Week Participants Cook their own Meals[a]



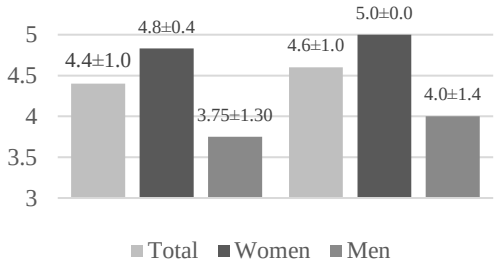
[a]The Y-axis indicates hours per week.

statement, “I plan to discuss at-home cooking with my future patients”, 30% said they strongly agreed, 20% said they agreed, and 50% said they neither agreed nor disagreed (Figure 16).

Study Measures

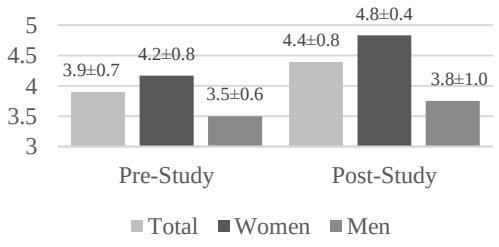
The following results are related to H_1; Participation in a week-long disease-based interactive nutrition course and culinary demonstrations is correlated with an increase in perceived importance of nutrition in the medical field in second year medical students. Participants were asked to indicate how much they agreed with the statement, “Nutrition is important in the medical field”. The mean response on the pre-study questionnaire was 4.4(±1.0), with a mean of 4.8(±0.4) for women and 3.8(±1.3) for men, and a mean of 4.6(±1.0) on the post-study questionnaire with a mean of 5.0(±0.0) for women and 4.0(±1.4) for men (Figure 17). The amount the participants agreed with this statement did increase, but not significantly (p=0.16). The mean response to the statement, “Nutrition will be important in my intended practice” was 3.9(±0.7) in the pre-study questionnaire with a mean of 4.2(±0.8)

Figure 17. Pre- and Post-Study Questionnaire Comparison: Nutrition is important in the medical field[a,b]



[a]Participants responded how much they agreed with the following statement: Nutrition is important in the medical field.
[b]A response of ‘5’ means strongly agree, and a response of ‘1’ means strongly disagree.

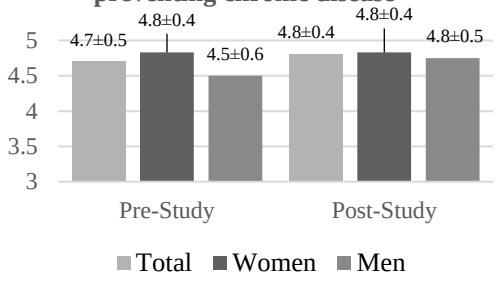
Figure 18. Pre- and Post-Study Questionnaire Comparison: Nutrition will be important in my intended practice[a,b]



[a]Participants responded how much they agreed with the following statement: Nutrition will be important in my intended practice.
[b]A response of ‘5’ means strongly agree, and a response of ‘1’ means strongly disagree.

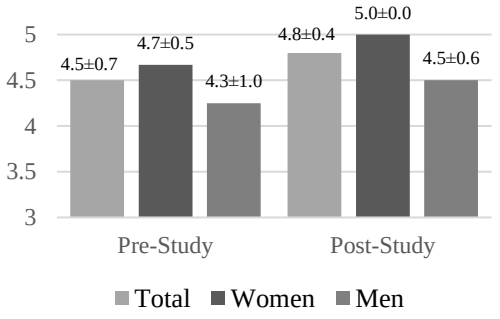
for women and 3.5(±0.6) for men, and a mean of 4.4(±0.8) in the post-study questionnaire with a mean of 4.8(±0.4) for women and 3.8(±1.0) for men (Figure 18).

Figure 19. Pre- and Post-Study Questionnaire Comparison: Nutrition is important for preventing chronic disease[a,b]



[a]Participants responded how much they agreed with the following statement: Nutrition is important for preventing chronic disease.
[b]A response of '5' means strongly agree, and a response of '1' means strongly disagree.

Figure 20. Pre- and Post-Study Questionnaire Comparison: Nutrition is important for treating chronic disease[a,b]

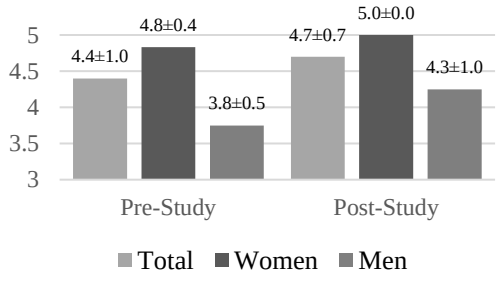


[a]Participants responded how much they agreed with the following statement: Nutrition is important for treating chronic disease.
[b]A response of 5 means strongly agree, and a response of '1' means strongly disagree.

The increase in the mean was not significant (p=0.06), but it indicated a statistical trend for an increased mean. The mean response to the statement "Nutrition is important for preventing chronic disease" was 4.7(±0.5) in the pre-study questionnaire with a mean of 4.8(±0.4) for women and 4.5(±0.6) for men, and a mean of 4.8(±0.4) in the post-study questionnaire with a mean of 4.8(±0.4) for women and 4.8(±0.5) for men (Figure 19). The increase was not significant (p=0.56). The mean response to the statement, "Nutrition is important for treating chronic disease" was 4.5(±0.7) in the pre-study questionnaire with a mean of 4.7(±0.5) for women and 4.3(±1.0) for men, and a mean of 4.8(±0.4) in the post-study questionnaire with a mean of 5.0(±0.0) for women and 4.5(±0.6) for men (Figure 20). The increase was not significant (p=0.18).

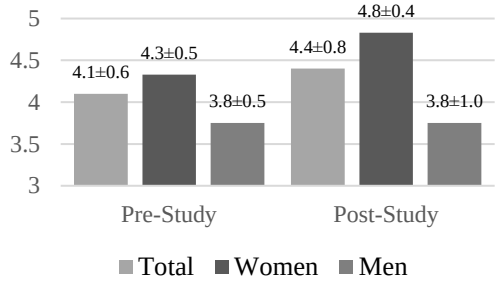
The following results are related to H_2: Participation in a week-long disease-based interactive nutrition course and culinary demonstrations is correlated with an increase in

Figure 21. Pre- and Post-Study Questionnaire Comparison: Nutrition is relevant in the medical field[a,b]



[a]Participants responded how much they agreed with the following statement: Nutrition is relevant in the medical field.
[b]A response of '5' means strongly agree, and a response of '1' means strongly disagree.

Figure 22. Pre- and Post-Study Questionnaire Comparison: Nutrition will be relevant in my intended practice[a,b]



[a]Participants responded how much they agreed with the following statement: Nutrition will be relevant in my intended practice.
[b]A response of '5' means strongly agree, and a response of '1' means strongly disagree.

perceived relevance of nutrition in the medical field in second year medical students. Participants were asked how much they agreed with the following statement, "Nutrition is relevant in the medical field". The mean response in the pre-study questionnaire was 4.4(±1.0) with a mean of 4.8(±0.4) for women and 3.8(±0.5) for men, and a mean of 4.7(±0.7) in the post-study questionnaire with a mean of 5.0(±0.0) for women and 4.3(±1. 0) for men (Figure 21). The increase was not significant (p=0.08). The mean response to the statement, "Nutrition will be relevant in my intended practice", was 4.1(±0.6) in the pre-study questionnaire with a mean of 4.3(±0.5) for women and 3.8(±0.5) for men, and a mean of 4.4(±0.8) in the post-study questionnaire with a mean of 4.8(±0.4) for women and 3.8(±1.0) for men (Figure 22). The increase was not significant (p=0.18).

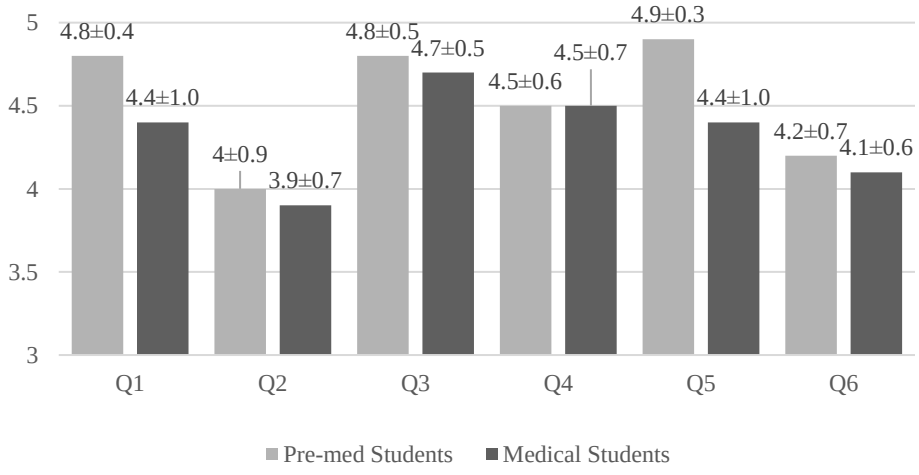
The study measure results were also analyzed using a sum score and average score of the pre- and post-study questionnaire to determine the data trend. The results of the Wilcoxon signed rank test for these data gave a p-value of 0.08, which suggests a statistical trend towards an increase in perceived importance and relevance of nutrition.

Th effect size was also calculated to be 0.27 for perceived importance of nutrition in the medical field, and 0.30 for perceived relevance of nutrition in the medical field. These suggest a medium effect size.

Additional Analyses

Pre-med student feedback indicated that the questionnaire was clear and easy to understand, therefore no major changes were made. When comparing the pre-med student responses for the study measure questions to the pre-study responses from medical students, the pre-med students' averages responses were consistently higher than the medical students' average (Figure 23). However, their average responses were not statistically different—all p-values >0.05.

Figure 23. Pre-Med vs. Medical Student[a] Responses on the Importance and Relevance of Nutrition[b,c]



[a] The Medical Student data are the pre-study responses.
[b]All of the questions were asked in the format, "How much do you agree with the following statement: 'Statement'". The following explanation of the questions will only list the statements.
Q1=Nutrition is important in the medical field.
Q2= Nutrition is important in my intended practice.
Q3= Nutrition is important for preventing chronic disease.
Q4= Nutrition is important for treating chronic disease.
Q5= Nutrition is relevant in the medical field.
Q6= Nutrition is relevant in my intended practice.
[c]A response of '5' means strongly agree, and a response of '1' means strongly disagree.

CHAPTER 5
DISCUSSION

The purpose of this study was to test the feasibility of a nutrition course with culinary demonstrations that aims to favorably influence medical students' perceived importance and relevance of nutrition in the medical field. Because medical students receive little to no nutrition education through their conventional courses, as verified by the medical students' responses, implementing a short (week-long) course focused on raising students' awareness of how nutrition can be used in the medical field may be a helpful tool for changing students' perceptions towards nutrition. Although a course of this length, may not be able to provide students with a comprehensive nutrition education, it can give them examples of how nutrition can be used for preventing, managing, and treating patient illnesses and it can provide students with resource.

The results of this study suggest that medical students' perceptions of the value of nutrition in medicine may shift in a favorable direction following an interactive nutrition course that included a cooking component. These are very preliminary findings and must be interpreted with caution. However, this study did demonstrate the feasibility of implementing a nutrition course as a Selective 1-week curriculum block embedded in the medical curriculum. The course focus, 'Food as Medicine', introduced the medical students to health concepts that are not provided in the medical curriculum. Importantly, when the students were asked how much they agreed that nutrition is important in their intended practice, their collective post-course score improved favorably from the pre-course score nearly reaching significance ($p=0.06$).

When comparing the responses based on gender, the women in this study tended to agree more with the statements regarding the importance and relevance of nutrition in comparison to the men, and overall, women had higher averages for both the pre- and post-study responses for the study measures as compared to the men. The average response for both women and men increased when they were asked if they agreed that nutrition was important and relevant to the medical field. However, when asked if nutrition would be important in their intended practice, the women's average response increased twice as much as the men's (Figure 18). When asked if nutrition would be relevant in their intended practice, the men's average did not change. This might suggest that despite agreeing that nutrition is important and relevant, the male medical students are less likely than the women to use nutrition in their practice

Students did not have an opportunity to provide formal feedback about the effectiveness of the study design, however they did provide informal feedback at the end of the week. Students felt that the cooking portion of the class improved their retention of course material and made the information overall more memorable. Many of them also indicated that they chose this Selective because there was an interactive portion (the cooking class). This reinforces the importance of incorporating the cooking class with a skilled chef into such courses and future study designs as a way to promote knowledge retention and to positively influence students' attitudes towards nutrition. Finally, students agreed that they felt more educated in nutrition than when they started the course. This comment is reflected in the data, as students' response to "I can adequately provide nutrition counseling" increased from the pre-study to the post-study questionnaire. Although it was not a major goal of this study to improve students' ability

to provide nutrition counseling, this comment and response indicate that a study with a similar study design could be used for that purpose.

The pre-med student responses to the study measure questions were not statistically different than the medical students, which indicates that the first-year medical students likely have had a similar nutrition education as the pre-med students. More than half of these student groups indicted that they had not received formal nutrition education (Figure 8). Interestingly, the medical students' responses were consistently lower than the pre-med responses. A question for future investigation would be whether there may be an association between attending medical school the belief that nutrition is not important in the medical field.

The results of this feasibility study support the implementation of a randomized, parallel-arm experimental study, adequately powered, to examine the impact of an interactive nutrition course with a culinary component on the nutrition beliefs of medical students. Furthermore, this study could continue as a Selective for the Mayo Clinic School of Medicine (MCSM) or other medical schools. The design of this study offers flexibility of course content and thus could easily be adapted to other medical schools and to the availability of different nutrition and health professionals.

This study was unique in that the participants were not practicing professionals; therefore, behavior changes could not be measured and the short class length (20 hours) allotted by MCSM for this selective did not allow sufficient time to provide students with an adequate nutrition education. Therefore, aiming to change the medical students' attitudes was the most appropriate method of teaching them about nutrition and

measuring the impact the study had on the students. This study is possibly the first study to look at attitude changes in medical students on nutrition. Although attitude changes do not necessarily provide immediate observable results in the students and how they interact with those around them (including patients and peers), attitude does play an important role in behavior change. Behavior change models such as the Theory of Reasoned Action and the Theory of Planned Behavior indicate that in order to observe a change in behavior, attitudes must be changed first[150]. A student must believe nutrition is important or they will not use it in their practice. By working towards improving students' attitudes towards nutrition, this study is setting the foundation for them to incorporate nutrition into their practice—though this cannot be immediately observed through the study. In order to observe this behavior, a longitudinal study that follows students into their practice is necessary.

Limitations

The initial student responses on the pre-study questionnaire suggest that the self-selection of this selective created a bias in our study population. None of the questions regarding the importance or relevance of nutrition had an average lower than '3.5'. In other words, none of the averages indicated that students disagreed or strongly disagreed that nutrition was important and relevant to the medical field. Because of this, there was less potential for the responses to increase, which may have limited the potential for significant results. Randomly choosing participants could help reduce participant bias. Additionally, using a 7-point Likert scale instead of a 5-point Likert scale could increase the possibility for significant changes to be identified. Another limitation of this study was the small sample size, which also made it difficult to achieve significant results.

Because students self-selected for this course a larger sample size could not be chosen. Future studies may want to repeat this study design over the course of several Selective sessions in order to compile data from at least 70 students. This would increase the study power to 80% and provide clearer results about the impact of this study. Some issues that may need to be addressed with a larger sample size include controlling for students who have already received a thorough nutrition education, such as students who have a degree or certificate in nutrition and acquiring enough funding to account for the larger population, which would increase the amount of food needed for the cooking-class portion. Finally, this study lacked a control group. Future studies may want to use students who are not attending this Selective, but who are in the same medical school class as the participants, as the control group. However, this group could pose a bias against nutrition, therefore it may be necessary to create a more diverse control group. The constraint will be low for the control group students who will only need to complete the pre- and post-study questionnaires.

Conclusion and Future Applications

Although this study design was intended for medical students, it can easily be applied to physicians or other health professionals. Using this design with practicing professionals would not only help to inform these individuals about nutrition, but it would also provide an opportunity to measure behavior change due to the Food as Medicine Selective or course. Furthermore, by using this design with practicing health professionals, patients would more immediately benefit from their practitioner's knew

attitudes and knowledge of nutrition, which could increase the overall impact of this study.

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APPENDIX A

IRB APPROVAL

ASU Knowledge Enterprise Development

EXEMPTION GRANTED

Carol Johnston
Nutrition
602/496-2539
CAROL.JOHNSTON@asu.edu

Dear Carol Johnston:

On 1/30/2019 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Food is Medicine Selective
Investigator:	Carol Johnston
IRB ID:	STUDY00009519
Funding:	Name: Graduate College (GRAD)
Grant Title:	
Grant ID:	
Documents Reviewed:	• protocol, Category: IRB Protocol; • online ad, Category: Recruitment Materials; • online survey - premed students, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • survey medical students, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 1/30/2019.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator

cc:
Makenna Baum

APPENDIX B

SELECTIVE PROPOSAL FORM

Title of Proposed Selective: ____Food as Medicine_____

(See http://intranet.mayo.edu/charlie/mms-selectives/ to view existing selective offerings and examples of descriptions/objectives, etc.)

1. Description:
This course will combine lecture and interactive learning in a kitchen setting. Lectures will present the evidence base for the impact of diet interventions on chronic disease outcomes. Students will learn cooking strategies and technics for incorporating functional foods into meals and for preparing meal plans.

Draft Proposed Topics:
Day 1: The Keto Diet for brain cancer. Speaker Lee Renda, MS RD, Manager of Nutritional Services – Dignity Health
Day 2: Vinegar for blood glucose management. Speaker Carol Johnston, PhD, RD Professor, Arizona State University
Day 3: The anti-inflammatory diet. Speaker Dorothy Sears, PhD, Professor Arizona State University
Day 4: Eating for your genetics – focus on the MTHFR polymorphism. Speaker Jessica Knurick, PhD, RD, ToolBox Genomics
Day 5: Popular diets – focus on gluten-free diets. Speaker Glenn Gaesser, PhD Professor, Arizona State University

2. Structure:
5 classes/4 hours per class: Each class will begin with a case study activity and discussion. The speaker will present a 50 minute lecture with Q&A. A culinary presentation will follow which will include information regarding the food items, preparation techniques, strategies for home cooking, and talking points to have with patients. Students will be able to prepare food Student knowledge and perceptions of the topic will be assessed pre- and post-class.

3. Objectives:
To describe the impact of diet interventions on chronic disease outcomes
To identify medicinal food therapies
To create culinary knowledge and skill sets for practical use when discussing diet with patients and for personal use in the home kitchen

4. Duration:
One week long; 20 hours.
Date: March 11-15, 2019

5. Participants:
1st and /or 2nd year medical students and faculty

6. Location:
Nutrition Program kitchens at Arizona State University, Downtown campus

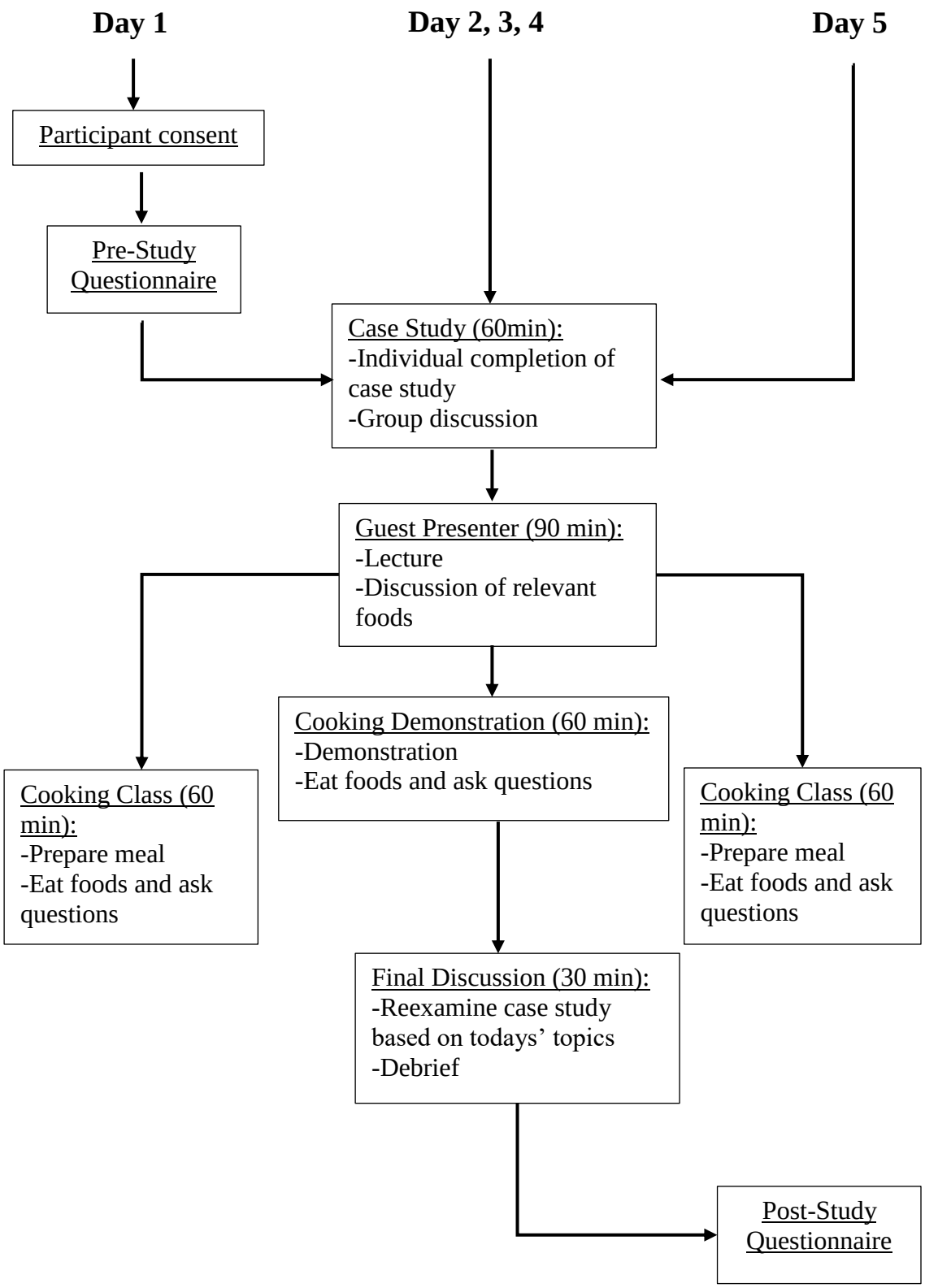
7. Requirements:
Affiliation with Mayo Medical School or Residency

8. Openings
~30 students/faculty

Mentor:
Coordinator:
SUBMIT PROPOSAL TO: **MMSARZCampus@mayo.edu**

APPENDIX C

STUDY FLOW


Day 1
Day 2, 3, 4
Day 5
Participant consent
Pre-Study Questionnaire
Case Study (60min):
-Individual completion of case study
-Group discussion
Guest Presenter (90 min):
-Lecture
-Discussion of relevant foods
Cooking Demonstration (60 min):
-Demonstration
-Eat foods and ask questions
Cooking Class (60 min):
-Prepare meal
-Eat foods and ask questions
Cooking Class (60 min):
-Prepare meal
-Eat foods and ask questions
Final Discussion (30 min):
-Reexamine case study based on todays' topics
-Debrief
Post-Study Questionnaire

APPENDIX D

TOPICS AND LECTURERS

Day 1: The Ketogenic Diet for brain cancer.

Speaker Lee Renda, MS RD, Manager of Nutritional Services – Dignity Health

Day 2: Eating for your genetics – focus on the MTHFR polymorphism.

Speaker Jessica Knurick, PhD, RD, ToolBox Genomics

Day 3: The anti-inflammatory diet.

Speaker Dorothy Sears, PhD, Professor Arizona State University

Day 4: Vinegar for blood glucose management.

Speaker Carol Johnston, PhD, RD Professor, Arizona State University

Day 5: Popular diets – focus on gluten-free diets.

Speaker Glenn Gaesser, PhD Professor, Arizona State University

APPENDIX E

CASE STUDIES

Case Study: Outpatient with an MTHFR Polymorphism

Case-Specific Learning Objectives

- ✓ Understand the signs of a MTHFR polymorphism
- ✓ Plan appropriate intervention when considering MTHFR polymorphism nutrient interactions

Our Patient: Nathan is a 9-year-old boy who has come in with his mother, Lori. Nathan is in 4th grade and attends the elementary school across from his house. He lives at home with both of his parents and his dog, Milo. He has a trampoline in the backyard and likes playing video games, though he is only allowed to play for one hour a day. He enjoys playing soccer in his little league after school and on the weekends with his friends. He is usually very excited to go to school and soccer and likes his teachers and coaches. The family frequently visits the park where Nathan plays with his friends and Milo can run around. Nathan's mother, a vegetarian, works as an administrator at a middle school and his father works as an engineer.

Medical and Surgical History: Nathan broke his arm when he was 6 years old and healed without complications. His growth is in the 50th percentile for both height and weight. His grandpa on his mother's side has had bypass surgery and his father has high blood pressure.

Home Medications: None

History of Current Illness: Lori notes that Nathan has been uninterested in playing soccer or seeing his friends the last few months. When asked if he likes school, Nathan responds that he thinks school is stupid and wishes he could stay at home. Lori says he has been spending more time inside and often takes long naps when he is home from school. Her biggest concern is that Nathan frequently talks about wanting to commit suicide. She insists Nathan was raised in a loving nurturing family and knows a 9-year-old should not be having these thoughts. Nathan has been to multiple psychiatrists and counselors, but nothing has seemed to help. Nathan has not been prescribed any medications.

Anthropometrics in the Doctor's Office

Height: 4 feet 5 inches
Weight: 66 pounds
Temperature: 98.6°F
Blood pressure: 110/70 mmHg
Pulse: 90 beats/minute
Oxygen saturation: 99%

Typical dietary intake:

Nathan enjoys eating, but he is a picky eater.
Breakfast: Toaster waffle with butter and real maple syrup and a glass of milk; Cheerios in milk with blueberries on the side.
Lunch at school: Sandwich with white bread, cheddar cheese, and mayonnaise, pretzels, and gummy bears; Cheese pizza with an apple and chocolate milk
Dinner at home: Pasta with marinara sauce, cooked spinach and mozzarella; White rice with butter, grilled chicken, and steamed broccoli with cheese on top. Lori says she tries to mix vegetables into his dinner since she knows he will not eat them for lunch at school.

Table 8.1 Fasting BMP Obtained One Week Prior to Doctor Appointment.

Laboratory Values	Normal Ranges or Values	Nathan's Values	Nathan's Value (WNL, High or Low)	Implications or Assessment
Glucose, mg/dL	70-110	100		
BUN, mg/dL	10-20	16		
Creatinine, mg/dL	0.5-1.1	0.75		
Sodium, mEq/L	136-145	137		
Chloride, mEq/L	98-5.0	101		
Potassium, mEq/L	3.5-5.0	4.7		
CO2, mEq/L	23-30	28		
Calcium, mg/dL	9.0-10.5	9.1		

Table 8.2 Fasting Selected Values from Complete Blood Count (CBC), Albumin, and Additional Labs Obtained One Week Prior to Doctor Appointment.

Laboratory Values	Normal Ranges or Values	Nathan's Values	Nathan's Value (WNL, High or Low)	Implications or Assessment
Hemoglobin, g/dL	12-16	11		
Hematocrit, %	37-47	37		
WBC, SI units	5-10	7		
Platelet count SI units	150-400	173		
Albumin	3.5-5.0	3.7		
HgbA1C, %	<6.0	5.5		
Transferrin, mg/dL	250-380	393		
Ferritin, ng/mL	10-150	20		
TIBC, mcg/dL	250-460	450		
Folate, ng/mL	5-21	20		
Vitamin B12, ng/mL	200-900	190		
Epinephrine, pg/mL	4-32	3		
Norepinephrine, pg/mL	20-108	27		
Dopamine, pg/mL	295-1123	352		

Adapted from: Skowron JM. MTHFR: Case Studies of Miracles, Mistakes, and a Thousand Pens. Naturopathic Doctors News & Review. Aug 2011.

https://ndnr.com/neurology/mthfr-case-studies-of-miracles-mistakes-and-a-thousand-pens/ Accessed on: February 23, 2019

Questions:

1. List in order of importance the Nathan's medical/nutritional concerns.

2. What is your evaluation of Nathan's height/weight status?

3. What is your general assessment of Nathan's overall nutrition intake prior to admit? What specific dietary questions or other information would you ask Nathan in a follow-up appointment?

4. List in order of importance Nathan's medical/nutritional concerns at admit.

5. Assume that Nathan has an MTHFR polymorphism. What information above may have alerted a healthcare team to conduct genetic testing?

6. Describe a desired prescription for Nathan.

Case Study: Glioblastoma Multiforme Management

- ✓ Understand when a restrictive ketogenic diet may be appropriate for non-epileptic patients
- ✓ Plan appropriate nutrition intervention when considering associated complications with the ketogenic diet

Our Patient: Greta is a 65 year-old retired dental hygienist. She is married, has two children and four grandchildren. She smoked for twenty-five years before quitting at age forty-five. Since retiring, Greta has been very active with her husband. They love to travel and would typically go to National Parks to hike each summer. Greta has been taking yoga classes two or three evenings per week for the last two years.

Medical and Surgical History: Greta had an appendectomy when she was ten. When she was eighteen she started getting headaches periodically that typically occurred before her period. At age thirty-seven, she had a hysterectomy. When she was forty-four, she was diagnosed with chronic erosive gastritis and controlled it with antibiotics and the elimination of alcohol from her diet. Greta has had familial hypercholesterolemia for 10 years now. Her family history includes breast adenocarcinoma (mother), and ovarian carcinoma (sister).

Home Medications: Greta takes Atorvastatin (Lipitor) to help control her cholesterol. Greta's daughter brings over a variety of over-the-counter natural products for her to take to improve her cholesterol and to help prevent another incident from her chronic gastritis. Greta only takes these products a few times per week because she feels they do not help her. These products include garlic supplements, Hawthorne berry supplements, and CoQ10.

History of Current Illness: Greta was admitted to your hospital 2 weeks ago. She presented with progressive memory loss, chronic headaches, and nausea. The symptoms were present, off-and-on, for about one month prior to diagnosis. Neurological examination showed mild left superior harm and facial paresis.

Admitting Data

Height: 5 feet 2 inches
Weight: 141 pounds. Greta reported a usual weight of 150 pounds at her last doctor's appointment and noted the weight loss is probably due to her eating less because of her nausea.
Hand grip strength using dynamometer: Below average for age
Temperature: 98.6°F
Blood pressure: 120/70 mmHg
Pulse: 95 beats/minute
Oxygen saturation: 98%

Hospital Admit (Day 1): Greta had an MRI, which disclosed a large multi-centric solid necrotic tumor in the right hemisphere (Figure 1). The tumor extends into the right temporal lobe, the insular lobe, the frontal operculum, the putamen, and head of the caudate nucleus. The tumor is

also surrounded by extensive edema. Greta was started on an anti-inflammatory steroidal therapy (dexamethasone, 16 mg/day IV) and anti-epileptic therapy (Topiramate, 50 mg/2×/day and Clobazam, 50 mg/day). Laboratory tests revealed an unremarkable complete blood count. Liver and renal functions were within normal limits. Blood biochemistry was essentially normal.

Laboratory Values	Normal Ranges or Values	Greta's Values	Greta's Value (WNL, High or Low)	Implications or Assessment
Glucose, mg/dL	70-110	130		
BUN, mg/dL	10-20	18		
Creatinine, mg/dL	Female: 0.5-1.1	0.8		
Sodium, mEq/L	136-145	142		
Chloride, mEq/L	98-106	100		
Potassium, mEq/L	3.5-5.0	4.2		
CO2, mEq/L	23-30	28		
Osmolality, mOsm/kg H2O	285-295	290		

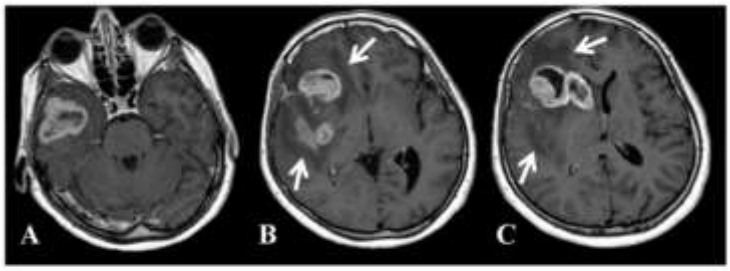


Figure 1
MRI contrast enhanced images of a large multi-centric mass involving the right hemisphere pole. (A) Temporal pole, (B) frontal operculum, insular lobe, posterior putamen, (C) frontal operculum, head of caudate nucleus. Note the presence of peripheral edema (arrows).

Hospital (Day 10-12): Greta underwent right frontal temporal craniotomy involving partial excision of the temporal pole with incomplete debulking. The histopathological examination showed patterns of glioblastoma multiforme (aggressive glioma brain tumor). A postoperative CT scan revealed an increase in edema to the left of the midline structures. During the

immediate post-operative recovery period, the patient started a self-imposed water only fast for two days. Prior to fasting, the patient's average daily calorie intake was about 1700-1800 kcal/day.

Laboratory Values	Normal Ranges or Values	Greta's Values	Greta's Value (WNL, High or Low)	Implications or Assessment
Hemoglobin, g/dL	Female: 12-16	12		
Hematocrit, %	Female: 37-47	38		
WBC, SI units	5-10	5		
Platelet count SI units	150-400	200		

Adapted from: Zuccoli G, Marcello N, Pisanello A, et al. Metabolic management of glioblastoma multiforme using standard therapy together with a restricted ketogenic diet: Case Report. *Nutr Metab (Lond)*. 2010;7:33. Published 2010 Apr 22. doi:10.1186/1743-7075-7-33 https://nutritionandmetabolism.biomedcentral.com/articles/10.1186/1743-7075-7-33

Questions:

1. List in order of importance Greta's medical/nutritional concerns.

2. What is your evaluation of Greta's height/weight status? Would you encourage Greta to gain weight as she receives treatment post-op?

3. Are there laboratory values or vital signs that would be a concern regarding Greta's condition? Explain.

4. There is visible tumor remaining after Greta's surgery. Describe the standard follow-up treatment under these circumstances.

5. What are your nutrition recommendation for Greta post-op? What specific dietary modifications would you recommend?

6. Do you agree with Greta taking multivitamin/mineral supplements post-op?

Case Study: Inpatient/Outpatient with Hypertension, Hyperlipidemia following a Myocardial Infarction

Case-Specific Learning Objectives

- ✓ Assess risk of developing additional complications from hypertension and hyperlipidemia.
- ✓ Plan appropriate intervention using the therapeutic lifestyle changes (TLC) principles.

Our Patient: Amy S. is a forty-eight-year-old accountant. She is employed with a large accounting firm in a large city and works eight to ten hour days each week. She is married and has two grown children in their mid-twenties. She takes public transportation into the city to work each day. This commute consists of walking half a mile each morning and afternoon. Amy stops by the market two to three days per week after work and carries her groceries on this half a mile walk. Amy loves to walk in the local parks on weekends and typically walks a few miles each weekend. Amy has a brother and sister who both have hypertension and high cholesterol. Her brother is three years older and had "artery bypass surgery in three veins" when he was fifty years old. Both of her parents passed away from "heart disease" when they were in their early seventies.

Medical and Surgical History: Amy suffered a broken right wrist when she was twelve. She had all of the typical childhood illnesses. Amy reports for annual check-ups each year and her blood pressure and lipid levels have been borderline upper limit normal for the past three years. She received brief education regarding lowering her salt and saturated fat intake three years agos. Due to Amy's strong family history of cardiovascular disease, she has been "fairly compliant" with this education. Amy does admit to some days where she cheats on her diet and exercise regime.

Home Medications: Amy started to take Lopressor to control her blood pressure and combination lovastatin–niacin to control her blood lipid levels three years ago.

History of Current Illness: Amy had just finished her shopping and was a block from her home when she started to feel lightheaded, nauseated, and dizzy. She was carrying one heavy bag of groceries and dropped it on the street. A college student stopped to help her. He noticed that Amy appeared uncomfortable and complained of chest, arm, and jaw pains. He immediately called 911 and the paramedics transported Amy to the local hospital.

Emergency Room (ER) and Day 1 Events: Amy presented to the ER in acute distress. Amy received sublingual nitroglycerine and oxygen. She received intravenous (IV) morphine to control her pain. Amy was transferred directly to the angiography suite where blockage of two major vessels was discovered. Amy received percutaneous coronary intervention (PCI) before being transferred to the cardiac care unit.

Anthropometrics

Height: 5 feet 3 inches; weight: 135 pounds

Body composition information: Unavailable

Laboratory Values and Pertinent Vital Signs

Amy's doctor ordered the following labs and vitals upon her arrival to the ER (nonfasting).

Table 3.4: Nonfasting BMP Obtained in the ER.

Laboratory Values	Normal Ranges or Values	Amy's Values	Amy's Value (WNL, High or Low)	Implications or Assessment
Glucose, mg/dL	70–110	165		
BUN, mg/dL	10–20	17		
Creatinine, mg/dL	Female: 0.5–1.1	0.8		
Sodium mEq/L	136–145	142		
Chloride, mEq/L	98–106	101		
Potassium, mEq/L	3.5–5.0	4.7		
CO_2, mEq/L	23–30	27		
Osmolality, mOsm/Kg H_2O	285–295	291		

Hospital Course: Amy remained in the hospital for a total of 2½ days. She had an uneventful stay in the cardiac care unit. She ate her "post-myocardial infraction (MI) cardiac progression" diet well. She took slow walks in the hallway when instructed to do so. Amy was interested in her in-hospital cardiac rehab education and was looking forward to participating in the outpatient cardiac rehab program at the hospital.

Discharge Medications: Amy received an angiotensin-converting-enzyme (ACE) inhibitor, beta-blocker, atorvastatin, and heparin in the hospital. She was discharged on the ACE inhibitor, beta-blocker, and atorvastatin. Her heparin was changed to Coumadin upon discharge.

Table 3.5: Non-Fasting Selected Additional Lab Values and Vital Signs Obtained in the ER.

Laboratory Values or Vital Signs	Normal Ranges or Values	Amy's Values	Amy's Value (WNL, High or Low)	Implications or Assessment
Hemoglobin, g/dL	Female: 12–16	15		
Hematocrit, %	Female: 37–47	39		
WBC, SI units	5–10	9.4		
Calcium, mg/dL	9.0–10.5	9.9		
Albumin, g/d	3.5–5.0	4.1		
Prealbumin, mg/dL	15–36	15		
Crp, mg/dL	<1.0	8.1		
HgbA1C, %	<6.0	5.2		
Cardiac troponins, ng/mL	<0.1	6.4		
Ischemia modified albumin, IU/mL	<85	127		
Temperature, °F	96.4–99.1	99.4		
Blood pressure, mmHg	Systolic <120 Diastolic <80	195/155, decreasing to 165/105 after nitrate administration in the ER		
Pulse, beats/minute	60–100	105		
Respirations: breaths/minute	14–20	22		
Pulse oximetry, %	≤95	98		

Table 3.6: Fasting Lipid Panel on Hospital Day 2.

Laboratory Values	Normal Ranges or Values	Amy's Values	Amy's Value (WNL, High or Low)	Implications or Assessment
Triglycerides, mg/dL	Female: 35–135	288		
HDL, mg/dL	Female: >55	50		
LDL, mg/dL	60–180	215		
Total cholesterol, mg/dL	<200	265		

Rehabilitation Course: Amy was referred to an outpatient cardiac rehabilitation program which provided diet, exercise, and lifestyle changes Amy needed to make for long-term health benefits. Amy met with a Registered Dietitian Nutritionist for a comprehensive nutrition therapy plan. When reporting her typical dietary intake, Amy noted she ate everything YOU ate and had to drink yesterday :)

Questions:

1. List in order of importance Amy's medical/nutritional concerns.

2. Are there laboratory values or vital signs above that would be a concern regarding Amy's condition upon admit to the hospital/ER?

3. Amy was at risk for having a MI. Describe her risk factors.

4. What is your evaluation of Amy's current height/weight status?

5. What is your general assessment of Amy's dietary recall? Do you feel she is consuming adequate, excessive, or deficient energy and protein based on her nutritional requirements?

6. Can you determine if Amy may have been compliant with a low sodium and low saturated fat diet prior to her MI? Explain.

7. What are the Therapeutic Lifestyle Changes.

Case Study: Outpatient Diagnosed with Type 2 Diabetes Mellitus Requiring Insulin

Case-Specific Learning Objectives

- ✓ **Assess risk of developing complications associated with diabetes.**
- ✓ **Evaluate techniques for diagnosing type 2 diabetes.**
- ✓ **Plan an appropriate diet for an individual with type 2 diabetes.**
- ✓ **Understand the role and effects or oral hypoglycemic medications.**

Our Patient: Rick S. is a forty-five-year-old architect. He is married and has a twelve-year-old son and a fourteen-year-old daughter. Rick's wife is a nurse and works at the local elementary school. Rick owns his business and typically works ten hours per day. He does like to jog each morning and coaches his son's soccer team three nights per week. He does not smoke or take illicit drugs.

Medical and Surgical History: Rick was very athletic when he was younger. He played soccer and basketball until he was in eighth grade. He suffered a broken right radius and ulna after falling off his skateboard when he was eight. He broke three fingers playing basketball in junior high and tore his left rotator cuff during a football game during his junior year of high school. The shoulder injury in high school required surgical repair.

Four years ago, Rick went in for a routine check-up at the urging of his wife. He had not received a physical exam in several years. She noticed Rick was gaining weight, he complained of blurred vision, and easily becoming fatigued. Both of Rick's parents and his older brother have type 2 diabetes mellitus (DM). Rick was diagnosed with type 2 DM after blood work ordered at this appointment was performed. At the time of diagnosis, Rick's Hgb A1C was 9.4% and his weight was 235 pounds. Rick was placed on oral diabetic medications. He received education regarding blood glucose monitoring, diet modifications to promote weight loss, and overall care to minimize the risk of complications for the diabetic patient. Rick expressed concern for long-term complications with this diagnosis.

Home Medications: Rick has been taking Metformin and Glipizide daily since the diagnosis of type 2 DM. Medication doses have been adjusted over the past four years to control Rick's blood glucose levels.

History of Current Illness: Again at the urging of his wife, Rick scheduled a comprehensive follow-up appointment with his doctor. He has been having a difficult time controlling his blood glucose levels each day. His fasting morning blood glucose levels range from 180 to 200 mg/dL and his accuchecks during the day are running between 175 and 195 mg/dL. He reports feeling fatigued by the end of each day. He cites compliance with his diet, medication, and exercise regime.

Anthropometrics in the Doctor's Office

Height: 6 feet 0 inches; current weight: 205 pounds; weight four years ago: 235 pounds

Waist measurement: 42 inches

Body composition information: Unavailable

Hand grip strength with dynamometer: Normal limits for age

Temperature: 98.6°F

Blood pressure: 125/80 mmHg

Pulse: 75 beats/minute

Oxygen saturation: 99%

Table 4.5: Fasting BMP and Osmolality Obtained Four Days Before Scheduled Appointment

Laboratory Values	Normal Ranges or Values	Rick's Values	Rick's Value (WNL, High or Low)	Implications or Assessment
Glucose, mg/dL	70–110	188		
BUN, mg/dL	10–20	15		
Creatitnine, mg/dL	Male: 0.6–1.2	1.0		
Sodium, mEq/L	136–145	142		
Chloride, mEq/L	98–106	102		
Potassium. mEq/L	3.5–5.0	4.7		
CO_2, mmol/L	23–30	28		
Osmolality, mOsm/Kg H_2O	285–295	292		

Typical Dietary Intake

Breakfast: A quick meal consisting of coffee with creamer and sugar; Greek yogurt and granola or a bagel and a piece of fresh fruit.

Lunch at work: Some type of deli take-out meal is delivered to Rick at the office. He usually has a large meat sandwich (turkey or roast beef with cheese and veggies) and either a cup of hearty soup or a salad (pasta, three bean, cole slaw, or potato). He will snack on either fresh or dried fruit and a few handfuls of nuts during the day. Rick cites his lunch serving sizes as "typical take-out portions."

Dinner at home: Baked or grilled meat: usually chicken, steak, or fish plus potatoes; rice or pasta; a dinner roll or piece of whole grain bread with butter and a large mixed veggie salad with assorted dressings. Rick only occasionally has alcohol since his diagnosis; he will have a

glass or wine or beer with dinner a couple nights a month. Rick cites his dinner serving sizes as "large." Rick drinks a lot of iced tea during the day and switches to water when he arrives home from work.

Physician Recommendations: Rick's physician was pleased with his overall weight and compliance to his medical therapies. His physician was concerned about Rick's overall increasing fasting and postprandial blood glucose levels. He determined that Rick would benefit from insulin therapy and ordered 6 units of Lispro and 10 units of Lantus to be administered each morning in addition to Rick's previous medications.

Questions:

1. List in order of importance Rick's medical/nutritional concerns.

2. Are there any laboratory values or vital signs above that would be a concern with regards to Rick's current condition?

3. Rick was diagnosed with type 2 diabetes four years ago. Describe how this is typically diagnosed.

4. What is Rick's percentage of weight change over the last four years? Are there any concerns regarding this weight change? Explain.

5. Would you encourage Rick to lose more weight at this time? Explain.

6. What is your general assessment of Rick's typical dietary intake? Do you feel he is consuming adequate, excessive, or deficient energy and protein based on his nutritional requirements?

CHAPTER 5

Gastrointestinal Concerns

Case Study: Outpatient with Celiac Disease

Case-Specific Learning Objectives

- ✓ Identify pros and cons of specific diagnostic tests for celiac disease.
- ✓ Identify potential nutritional deficiencies that may develop in individuals with celiac disease and determine appropriate supplementation as indicated.
- ✓ List nutritional and nonnutritional sources of gluten.
- ✓ Plan a gluten-free diet and make appropriate substitutions for gluten containing foods in a typical diet.

Our Patient: Sarah H. is a twenty-one-year-old college junior. She is currently working her way through college and will obtain a degree in education. Her goal is to be a first grade teacher. She currently lives in a small house with two additional roommates. All three students are working their way through college and are mindful of unnecessary expenses. The young women take turns cooking evening meals and always shop the sales for food, toiletries, and cleaning supplies. Due to their busy schedules, the three women have a schedule to split up the cooking, cleaning, and laundry responsibilities.

Three months ago, Sarah was hired as a nanny for a family with four-year-old twins. One of her employers is an architect and the other is an artist. Sarah works for this family three days per week from noon to 6:00 p.m. Every day at work, Sarah prepares lunch for the twins and gives them afternoon snacks. Sarah is pleased that she is able to eat with the twins and believes her overall nutritional intake is improving on the days she works. Since the twin's mother is an artist, they have a small art studio and playroom next to their bedroom. It is filled

with assorted art supplies including paper, crayons, colored pencils, colored chalk, watercolors, acrylic paints, glue, stickers, clay, Play Doh, beads, and fabrics. There are four worktables in the room; two for art and two for games. One table always has a puzzle ready to be completed on it. Overall, Sarah considers herself to be moderately active in her job and walking around the college campus.

Medical and Surgical History: Sarah had her appendix removed when she was eight years old. The appendix did not rupture and she was discharged from the hospital the day after surgery. She was diagnosed with anemia when she was fourteen years old and has been taking iron sulfate supplements for the past seven years. She does not smoke or take illicit drugs. Sarah denies any food intolerances or allergies.

Home Medications: Iron sulfate.

History of Current Illness: Over the past three months, Sarah has been becoming progressively fatigued. She feels that her busy work and school schedule play a role in this, but was not sure if her anemia was getting worse. Over the last three months, Sarah reports a variable appetite and has noticed a 10 pound unintentional weight loss. For the past four to five years, Sarah has complained of generalized gastrointestinal (GI) issues. Sometimes, she has problems with constipation or gas. Typically after a bought of constipation, she gets a slight rash on her abdomen and legs. Sarah has always considered herself to have "dry, itchy and sensitive skin" and always uses body lotions to alleviate the dryness. She noticed that her dermatological issues have become worse since she has been in college. Sarah and her roommates only buy lotions, make-up, or laundry detergents that are on sale. She feels that these inexpensive products are making her skin issues worse. She felt she needed to discuss these issues with her family doctor and scheduled an office appointment. The doctor ordered some lab work to be obtained prior to her appointment.

Anthropometrics and Additional Data from Office Exam

Height: 5 feet 6 inches; current weight: 119 pounds; weight three months ago: 129 pounds

Handgrip strength: Average for age

Chest and lungs: Clear, normal breath sounds via auscultation

Heart: Normal rate and rhythm

Eyes and mucous membranes appear moist

Skin and nails: Pallor with koilonychias

Temperature: 98.4°F

Blood pressure: 110/70 mm/Hg

Pulse: 75 beats/min

Respiratory rate: 16 breaths/min

Pulse oximetry: 99%

Table 5.1: Fasting BMP and Osmolality Obtained One Week Prior to Sarah's Doctor Appointment.

Laboratory Value	Normal Ranges or Values	Sarah's Values	Sarah's Value (WNL, High or Low)	Implications or Assessment
Glucose, mg/dL	70–110	95		
BUN, mg/dL	10–20	18		
Creatinine, mg/dL	Female: 0.5–1.1	1.0		
Sodium, mEq/L	136–145	142		
Chloride, mEq/L	98–106	101		
Potassium, mEq/L	3.5–5.0	4.7		
CO2, mEq/L	23–30	27		
Osmolality, mOsm/kg H2O	285–295	289		

Table 5.2: Fasting Selected Values from Complete Blood Count (CBC), Albumin, and Additional Labs Obtained One Week Prior to Sarah's Doctor Appointment.

Laboratory Value	Normal Ranges or Values	Sarah's Values	Sarah's Value (WNL, High or Low)	Implications or Assessment
Hemoglobin, g/dL	Female: 12–16	10		
Hematocrit, %	Female: 37–47	32		
WBC, SI units	5–10	10.2		
Total cholesterol, mg/dL	<200	155		
Albumin, g/dL	3.5–5.0	3.1		
Prealbumin, mg/dL	15–36	13		
CRP, mg/dL	<1.0	5		
HgbA1C, %	<6.0	4.8		
Transferrin, mg/dL	Female: 250–380	391		
Ferritin, ng/mL	Female: 10–150	8		
TIBC, mcg/dL	250–460	473		
Folate, mcg/dL	200–200	178		
Vitamin B12, pg/mL	160–950	147		

Typical Dietary Intake

Breakfast consists of: coffee with creamer and sugar; Greek yogurt and granola/cereal or a bagel, small glass of milk or fresh juice; and a piece of fresh fruit.

Lunch at work with the twins: Macaroni and cheese or some sort of sandwich plus milk and a piece of fruit. They always have cookies or ice cream for dessert.

Dinner at home with the roommates: Baked or grilled meat; usually chicken or fish plus potatoes, rice or pasta, and a large mixed veggie salad with assorted dressings. Evening dessert always consists of fresh or frozen fruit. Sarah does have a glass of beer or wine on weekends.

Sarah usually drinks several glasses of water or plain iced tea with lemon each day. She avoids soft drinks.

Questions:

1. List in order of importance Sarah's medical/nutritional concerns.

2. What is celiac disease? Is celiac disease a condition that individuals are born with, or are there specific risks or triggers that can promote disease? Explain.

3. Describe how celiac disease causes damage to the small intestine.

4. Anemia is a common concern in individuals with celiac disease. Explain why.

5. What type of diet must an individual consume for several weeks prior to testing for celiac disease? Explain.

6. Sarah's family practitioner suspects Sarah may have celiac disease. Additional tests should be performed to confirm this diagnosis and their accuracy among specific populations or age groups.
    a. Small bowel biopsy

b. Antibodies
   Anti-tissue transglutaminase antibody (tTG-IgA and IgG)

   Antiendomysial antibody (EMA-IgA)

   Antigliadin antibody (AgA-IgG and IgA)

c. Genetic testing
   Human leukocyte antigen (HLA)DQ2/DQ8

7. What is the overall assessment of Sarah's anthropometric and physical assessment data from her office exam?

APPENDIX F

RECIPES

Ketogenic Diet:

Mock PF Chang's Beef Lettuce Wraps

Serves 4

Ingredients:

- 2 tablespoons olive oil
- 4 ounces white or cremini mushrooms (about 6), stem and caps diced
- 1 medium onion, diced (about 1 ½ cup)
- ¼ teaspoon ground black pepper
- 1 tablespoon ground ginger
- 2 cloves garlic, minced (about 2 teaspoons)
- ¼ cup beef broth
- ¼ cup tamari or soy sauce
- 1 tablespoon sriracha
- 1 tablespoon rice wine vinegar, unseasoned
- 1 pound high-fat ground beef
- 2 green onions, sliced thin
- 4 full leaves of iceberg lettuce

Instructions:

1. Heat olive oil in a medium-sized skillet over medium heat. Add mushrooms and cook without stirring for about 4 minutes or until the mushrooms start to brown. Add onions, pepper, ginger, and garlic and cook until onions begin looking translucent.
2. Mix broth, tamari or soy sauce, sriracha, and rice wine vinegar in a small bowl. Set aside.
3. Move the vegetables to the outer edges of the skillet and add the ground beef to the center. Leave it to cook until you notice it browning on the pan-side (about 6-8 minutes). Break it into small pieces with a spoon and stir periodically until cooked throughout.
4. Pour in the sauce and stir all ingredients until well combined.
5. To assemble, fill the lettuce leaves with the meat mixture and top with sliced green onion.

*Recipe adapted from https://eatinnotout.wixsite.com/eatinnotout/single-post/2017/11/19/PF-Changs-Lettuce-Wraps

Ketogenic Diet:

Mushroom and Feta Stovetop Frittata

Serves 4

Ingredients:

- 4 ounces white or cremini mushrooms (about 6 or 1 cup chopped) mushrooms
- 8 eggs
- 6 tablespoons heavy cream
- 2 tablespoons water
- ¼ teaspoon salt
- ¼ teaspoon ground black pepper
- 2 tablespoons salted butter
- 2 cups baby spinach
- 2 ounces crumbled feta cheese (about 1/3 cup packed)
- 8 cherry tomatoes cut into quarters

Instructions:

1. Turn the oven to broil.
2. Rinse the mushrooms and pat dry with paper towels. Pull off the caps and chop then slice the cap into thin slices.
3. Whisk eggs, cream, water, salt and pepper in a bowl and set aside.
4. Add butter to an oven-safe skillet over medium heat. Once butter has melted, add mushrooms and cook without stirring until mushrooms begin to brown (about 5 minutes).
5. To the skillet, add spinach, reduce heat to medium low and stir until wilted (about 2 minutes).
6. Spread the mushrooms and spinach evenly on the bottom of the pan. Pour the egg mixture over the vegetables, cover, and cook for about 5-7 minutes or until the egg begins to set.
7. Add the feta and tomatoes to the eggs and place the skillet in the oven for 2 minutes or until the frittata surface begins to brown on top.
8. The frittata can be sliced like a pie to serve hot or refrigerated and re-warmed gently or served slightly chilled or at room temperature.

*Recipe adapted from https://www.essentialketo.com/portobello-mushroom-and-feta-frittata

MTHFR Gene Diet:

Roasted Broccoli and Chicken Quinoa Bowl with Peanut Ginger Dressing
Serves 4
Instructions:

- 2 cups broccoli florets, chopped into bite-sized pieces (about 1 head of broccoli)
- 2 teaspoons + 1 tablespoon olive oil
- ¼ teaspoon salt
- ¾ cup uncooked quinoa
- 1 ½ cup water
- ¼ cup chunky peanut butter
- 1 tablespoon honey
- 2 teaspoons peeled fresh ginger, grated
- 3 tablespoons tamari or soy sauce
- 3 tablespoons apple cider vinegar
- 1 ½ teaspoons pure (dark) sesame oil
- 1 teaspoon sriracha
- 1 cup red cabbage, shredded
- 1 red bell pepper, sliced thin
- 1 cup edamame, shelled
- ½ cup cilantro, chopped
- 1 pound cooked (poached, baked, grilled, etc) chicken breast, shredded
- Optional: ½ teaspoon red pepper chili flakes

Instructions:

1. Pour quinoa and 1 ½ cups broth in a medium-sized pot and place over medium heat. Bring quinoa to a boil, then reduce to a simmer and cover. Cook for about 15 minutes or until the quinoa is fluffy and the water is absorbed. Let it cool.
2. Preheat oven to 450F. Place broccoli on a foil-lined baking sheet. Drizzle with 2 teaspoons olive oil, using hands to coat evenly and sprinkle on the salt. Spread the broccoli out evenly on the sheet, place on the middle rack and roast for 15 minutes or until the edges start turning light brown.
3. Add peanut butter and honey to a microwave safe bowl and microwave for 10-20 seconds. Stir until smooth then mix in ginger, soy sauce, vinegar, sesame oil, 1 tablespoon olive oil, sriracha, and chili flakes.
4. Add broccoli, cabbage, bell pepper, edamame, cilantro and shredded chicken to a bowl. Pour in the sauce and mix.
5. Distribute desired amount of quinoa in bowls. Top with the vegetable mix and shredded chicken. Toss to combine.

* Recipe adapted from https://tastesbetterfromscratch.com/thai-quinoa-salad

MTHFR Gene Diet:

Chickpea Avocado Sandwich
Serves 4
Ingredients:

- 1 (16 ounce) can chickpeas
- 1 large avocado, chopped
- 3 tablespoons chopped cilantro
- 2 spring onions, about 3 tablespoons (white and green parts), chopped
- 3 tablespoons fresh lime juice, (about 1 lime)
- ½ teaspoon salt
- 2 ounces baby spinach (about 1 ½ cups packed down), chopped
- 8 slices whole wheat bread

Instructions:

1. Lightly toast the bread or leave untoasted if it is a dense bread.
2. Rinse and drain chickpeas. Place in a mixing bowl with the avocado and mash with a fork until a chunky paste. Add cilantro, green onion, lime juice, salt and chopped baby spinach.
3. Spread on a slice of bread, add the second slice and enjoy!

*Recipe adapted from https://www.twopeasandtheirpod.com/smashed-chickpea-avocado-salad-sandwich/#a5yp=1409813

Anti-inflammatory Diet:

Salmon and Blueberry Walnut Salad with Dijon Vinaigrette
Serves 4
Ingredients:

- 1 pound skinless, salmon fillet
- 1 tablespoon olive oil
- ¼ teaspoon salt
- 1 tablespoon honey
- ¼ cup balsamic vinegar
- ¼ teaspoon cracked fresh pepper
- 2 teaspoons Dijon mustard
- 6 tablespoons olive oil
- ½ teaspoon salt
- 4 cups greens (spinach, arugula, kale, etc.)
- 1 cup blueberries
- 4 ounces walnuts, chopped

Instructions:

1. Preheat the oven to 425F. Divide the salmon into four equal pieces. Place salmon on a foil covered baking sheet and drizzle olive oil on every part of the fillets. Sprinkle each piece with salt. Once the oven is preheated, bake the salmon for about 12-15 minutes or until the salmon has an internal temperature of 145F. Cool.
2. Mix honey, balsamic vinegar, pepper, Dijon mustard, 6 tablespoons olive oil, and ½ teaspoon of salt in a small bowl and set aside.
3. Put walnuts in a skillet and heat on medium heat. Toss or stir frequently until the walnuts smell fragrant and begin changing slightly in color (about 5 minutes).
4. Place greens, blueberries, and walnuts in a large bowl. Pour ¼ -1/3 cup of dressing on the salad and toss until dressed.
5. Place the salmon on the salad once cooked and drizzle additional dressing on the salmon. Serve immediately.
6. Save the remaining dressing for other uses.

Anti-inflammatory Diet:

Tropical Chia Seed Pudding
Serves 2
Ingredients:

- 4 tablespoons chia seeds
- 13.5 ounces light coconut milk
- 3 tablespoons honey
- ½ cup canned pineapple chunks, drained
- 1 medium banana
- ¼ cup raspberries
- 2 tablespoons chopped nuts

Instructions:

1. Mix chia seeds, coconut milk, and honey in a small bowl. Refrigerate for at least 4 hours.
2. Chop pineapples and banana into bite sized pieces. Place on top of chia seeds with the raspberries and almonds. Serve.

*Recipe adapted from http://www.foodnetwork.co.uk/recipes/coconut-chia-pudding-jars.html

Vinegar Inclusive Diet:

Vinegar Dressed Coleslaw
Serves 4-6
Ingredients

- 2 cups purple cabbage, finely sliced
- 2 cups green cabbage, finely sliced
- 2 cups carrots, grated (2 medium-sized carrots)
- ¼ cup flat-leaf parsley, chopped
- ¼ cup pepitas (pumpkin seeds), unsalted
- ¼ cup sunflower seeds, unsalted
- 2 tablespoons sesame seeds, unsalted
- ¼ cup olive oil
- Zest of ½ of a lemon
- ¼ cup apple cider vinegar
- 2 garlic cloves, minced, about 2 teaspoons
- ½ teaspoon ground cumin
- ¾ teaspoon salt

Instructions:

1. Combine cabbages, carrots, parsley, and seeds in a medium sized bowl. Set aside.
2. In a small bowl, mix olive oil, lemon zest, vinegar, garlic, cumin, and salt and whisk until blended.
3. Pour the dressing over the cabbage mixture and toss until well coated. Serve immediately or refrigerate for a couple of hours. If not serving within a couple of hours, consider leaving the seeds off and add them just before serving.

*Recipe adapted from *The Adventurous Vegetarian: Around the World in 30 Meals* By Jane Hughes

Vinegar Inclusive Diet:

Ginger Mint Vinegar Tea
Serves 8 (8-ounce servings)
Ingredients:

- 4 ounces (about eight 1-inch pieces) of ginger root *(about 1 cup when sliced ¼ inch)*
- 9 cups of water
- 8 bags flavorful tea *(Rooibos works well—it's decaffeinated, naturally sweet with hints of vanilla)*
- ½ ounce peppermint sprigs (2-3 sprigs) *(spearmint works but has lower levels of cooling menthol)*
- 1 tablespoon plus 1 teaspoon honey *(or 1 teaspoon liquid stevia)*
- 8 tablespoons apple cider vinegar *(or any mild 5% acetic acid vinegar)*

Tea options: Substitute in green or black teas—you may need to add more honey

Instructions:

1. Wash ginger root, remove any damaged spots with a knife or spoon edge. Slice into ¼" thick pieces.
2. Add water and ginger to a 4-quart saucepan over medium-high heat and bring to a boil, then reduce heat to rapid simmer for 5 minutes.
3. Remove from heat. Add tea bags and mint. Steep for 6-8 minutes. Remove tea bags, mint and ginger by straining or using a slotted spoon. Add honey and mix until honey dissolves.
4. If serving immediately, add vinegar. If storing tea in the refrigerator for cold tea or rewarmed hot tea, add the vinegar just before drinking and if using stevia instead of honey—also add just before drinking.

*Recipe from *The Taste Workshop* By Chef Michele Redmond, MS, RDN, FAND

Gluten-free diet:

Spaghetti Squash with Gluten-free Meatballs
Serves 4
Ingredients:

- 1 medium Spaghetti squash, about 5 cups
- 2 tablespoons + 1 teaspoon olive oil, divided
- ½ teaspoon salt
- ½ pound ground turkey, 85% lean
- ¼ pound Italian chicken or ground turkey sausage meat
- ½ ounce parmesan, shredded ¼ cup
- ¼ cup almond flour *(not meal)*
- 1 medium carrot, shredded fine (about ½ cup)
- 2 cloves garlic, minced
- 1 cup flat-leaf parsley, minced
- 1 large egg
- 24 ounces marinara sauce

Instructions:

1. Preheat the oven to 425F. Cut the squash in half longwise and scoop out the seeds. Place in a foil covered baking sheet, and drizzle with 1 tablespoon of olive oil and ½ teaspoon of salt both split between the two sides. Flip the spaghetti squash upside down and poke with a fork multiple times. Cook for about 30-35 minutes or until the squash is easily pulled apart. Allow the squash to cool until you can comfortably touch the outside. Gently scrape the squash out of the skin and place in a large bowl.
2. Heat the broiler. In a separate large bowl, combine the turkey, sausage, parmesan, almond flour, carrots, garlic, parsley, egg, and 1 tablespoon of olive oil. Rub a foil-lined baking sheet with 1 teaspoon of olive oil. Form the mixture into 2-inch balls (about 12 balls) and place them on the baking sheet. Put the pan on the middle rack and bake until cooked through (internal temperature of 165F), about 10-12minutes.
3. While the meatballs cook, warm the marinara sauce in a large skillet over low heat. Once cooked, toss the meatballs in the sauce to coat. Serve over the spaghetti squash.

*Recipe adapted from https://www.countryliving.com/food-drinks/recipes/a32583/turkey-meatballs-spaghetti-squash-recipe-122850/

Gluten-free diet:

Creamy Polenta, Hold the Cow
Serves 4 cups
Ingredients:

- 5 cups (118 cl) water
- 1 teaspoon (5 ml) salt
- 1 cup (6.5 ounces or 185 g) polenta corn meal (medium-grain coarse and not instant)

Optional: 2 tablespoons (12 g) nutritional yeast (a parmesan umami substitute)

Instructions:

1. Heat the salted water to a boil in a 2 or 3-quart pot. Pour in the polenta while whisking to avoid lumps forming.
2. Bring back to a boil, whisk several times as it begins to thicken (about 4-5 minutes), then reduce the heat to maintain a gentle simmer. To keep it from scorching or sticking, stir periodically with a long-handled spoon (hot polenta burps lava-like projectiles). If polenta becomes dry or too dense before the texture is soft, add some additional hot water.
3. When it reaches a creamy, soft scrambled egg texture (about 40-50 minutes depending the polenta), taste and season with salt or if using nutritional yeast, stir into the polenta, then taste. Remove from heat when done. It should be served without much delay or kept warm over a double-boiler.

Polenta tips:

- Medium-grain coarse corn meal makes a fluffier polenta than fine grain which can become pasty.
- Boiling water isn't required, but it can speed up the cooking of polenta.
- Water allows the polenta to taste more like corn than a chicken stock does. Marcella Hazan, famous Italian-American cook, promoted water as a stock in many dishes including polenta.
- Another cooking option is to put a lid on the pot to reduce the stirring frequency, however it can add to the cooking time a bit.

*Recipe from the *Culinary Nutrition Umami Workshop & Demo: Le Cordon Bleu, Paris*
By Michele Redmond, MS, RDN, FAND

APPENDIX G

SAMPLE SIZE CALCULATION

Author	Year	Change ±SD	n per group	Calculated n per group	Age range	Subject health status
Bekker GA[140]	2016	1.26+/-1.28	48	19	17-28 (median of 21)	NA/not applicable
Wall DE[141]	2011	.29+/-1.87	1025	329	9.31 ± 0.52	SNAP-Ed participating schools
Durr S[142]	2017	.5+/-1.1	61	78	31-55	Previously diagnosed with asthma
Saitoh A[143]	2017	.5+/-1.6	88-100	114	27-36	Pregnant women

APPENDIX H

PRE- AND POST-STUDY QUESTIONNAIRE

Medical School Students' Nutrition Attitudes

Dear Participant:
We are conducting a research study on the relationship between an interactive nutrition course and nutrition attitudes in second year medical students. If you are second year medical student at the Mayo Clinic School of Medicine taking the "Food as Medicine" selective, we would like to invite you to participate in a brief survey that will take 5-6 minutes to complete. As part of the study, we would appreciate your participation in this survey again at the completion of the study. As an incentive to participating in this study you will receive a $25, a recipe book, an apron. Your participation in this study is voluntary and anonymous and you may withdraw from the study at any time. By marking “agree" below and completing this survey, you are indicating consent.
If you have any questions concerning the research study, please contact the research team at: Dr. Carol Johnston, College of Health Solutions, HLTHN room 532, 550 N 3rd St Phoenix, AZ 85004, 602-496-2539, Carol.Johnston@asu.edu. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional

Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788.

Sincerely,
ASU "Food is Medicine" Research Team

- ○ Agree (1)
- ○ Disagree (2)

***Please write your anonymous ID number. The first letter of your middle name, your two digit birth month, and the last two digits of your phone number in that order.**

_____

Q1 Please indicate your gender

- ○ Male (1)
- ○ Female (2)
- ○ Other (3)

Q2 Please write your weight in pounds _____
Q3 Please write your height in inches _____

Q4 Do you have experience providing nutrition education or counseling?

- ○ Yes (1)
- ○ No (2)

Q5 Please indicate which types of nutrition education you have received prior to attending medical school. Mark all that apply.

- ☐ Graduate degree in nutrition (1)
- ☐ Undergraduate degree in nutrition (1)
- ☐ Undergraduate minor in nutrition (1)
- ☐ Undergraduate coursework (1)
- ☐ High school health education (2)
- ☐ Informal research due to personal interest (e.g. You learned about nutrition to improve your health.) (3)
- ☐ None (4)

Q6 Please indicate how many hours of nutrition education you have received through coursework and clinical work provided by the Mayo Clinic School of Medicine.

- ○ 0 hours (1)
- ○ 1-5 hours (2)
- ○ 6-10 hours (3)
- ○ 11-15 hours (4)
- ○ 16-20 hours (5)
- ○ 21 to 25 hours (6)
- ○ 26 or more hours (7)

Q7 How would you rate your dietary knowledge?

- ○ Very poor (1)
- ○ Poor (2)
- ○ Neither poor nor good (3)
- ○ Good (4)
- ○ Very good (5)

Q8 During your childhood (age 0-18), how important was it for your family to cook meals at home?

- Very unimportant (1)
- Unimportant (2)
- Neither unimportant nor important (3)
- Important (4)
- Very important (5)

Q9 Have you ever taken a cooking class?

- Yes (1)
- No (2)

Q10 How many times a week do you eat out?

- 0 times (1)
- 1-3 times (2)
- 4-6 times (3)
- 7 or more times (4)

Q11 How many times a week do you cook your own meals?

- 0 times (1)
- 1-3 times (2)
- 4-6 times (3)
- 7 or more times (4)

Q12 How many times a week do you cook with other people?

- 0 times (1)
- 1-3 times (2)
- 4-6 times (3)

- ○ 7 or more times (4)

Q13 How would you rate your diet quality?

- ○ Very unhealthy (1)
- ○ Unhealthy (2)
- ○ Neither unhealthy nor healthy (3)
- ○ Healthy (4)
- ○ Very healthy (5)

For questions 14-23, please indicate how much you agree with the following statements.

Q14 Medical school has adequately educated me in nutrition.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Q15 Medical school has adequately trained me in nutrition counseling

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Q16 I can adequately provide nutrition counseling.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Q17 I plan to discuss cooking at-home meals with my future patients.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Q18 Nutrition is important in the medical field.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Q19 Nutrition will be important in my intended practice.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Q20 Nutrition is relevant in the medical field.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Q21 Nutrition will be relevant in my intended practice.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Q22 Nutrition is important for preventing chronic disease.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Q23 Nutrition is important for treating chronic disease.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

APPENDIX I

PRE-MED STUDENT QUESTIONNAIRE

Pre-Med Students' Nutrition Attitudes

Dear Participant:
We are conducting a research study on an interactive nutrition course for second year medical students. If you are a student in your final year of your undergraduate degree and planning to apply for medical school, I would like to invite you to participate in this brief, 5-10 minute, survey. This survey will provide us with valuable insight that will ultimately improve the quality of our study data. Your participation in this survey is voluntary and completely anonymous and you may withdraw from it at any time. By clicking "agree" you are consenting to participate.
If you have any questions concerning this survey, please contact the principle investigator at: Dr. Carol Johnston, College of Health Solutions, HLTHN room 532, 550 N 3rd St Phoenix, AZ 85004, 602-496-2539, Carol.Johnston@asu.edu. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788.
Sincerely,
ASU "Food is Medicine" Research Team

- ○ Agree (1)
- ○ Disagree (2)

Q1 Are you planning to attend medical school?

- ○ Yes (1)
- ○ No (2)

Q2 Please indicate your gender

- ○ Male (1)
- ○ Female (2)
- ○ Other (3)

Q3 Please enter your weight in pounds.

_____

Q4 Please enter your height in inches.

_____

Q5 Please list your major(s)

Q6 Have you applied for medical school?

○ Yes (1)

○ In the process of applying (2)

○ No (3)

Q7 Do you have experience providing nutrition education or nutrition counseling?

○ Yes (Please explain) (1)
_____

○ No (2)

Q8 Please indicate which types of nutrition education you have received. Mark all that apply.

☐ Undergraduate degree in nutrition (Mark if you are currently completing your degree) (1)

☐ Undergraduate minor in nutrition (Mark if you are currently completing your minor) (1)

☐ Undergraduate coursework (1)

☐ High school health education (2)

☐ Informal research due to personal interest (e.g. You learned more about nutrition to improve your health.) (3)

☐ None (4)

☐ Other, (Please explain) (5)
_____

Q9 If you have used any professional stuy services, such as MCAT study guides or tutoring, to prepare for the MCAT or to prepare for medicals school, please indicate how

many cumulative hours of nutrition education they have provided. (Use your best judgment)

- ○ 0 hours (1)
- ○ 1-5 hours (2)
- ○ 6-10 hours (3)
- ○ 11-15 hours (4)
- ○ 16-20 hours (5)
- ○ 21 to 25 hours (6)
- ○ 26 or more hours (7)
- ○ I have not used professional study services (8)

Q10 How would you rate your dietary knowledge?

- ○ Very poor (1)
- ○ Poor (2)
- ○ Neither poor nor good (3)
- ○ Good (4)
- ○ Very good (5)

Q11 Please indicate how easy or difficult it was to understand the previous questions on this page.

- ○ Very difficult (1)
- ○ Difficult (2)
- ○ Neither difficult nor easy (3)
- ○ Easy (4)

○ Very Easy (5)

Q12 Please explain what could have made these questions easier to understand.

_____

Q13 During your childhood (age 0-18), how important was it for your family to cook meals at home?

○ Very unimportant (1)

○ Unimportant (2)

○ Neither unimportant nor important (3)

○ Important (4)

○ Very important (5)

Q14 Have you ever taken a cooking class?

○ Yes (Please elaborate) (1)
_____

○ No (2)

Q15 How many times a week do you eat out?

○ 0 times (1)

○ 1-3 times (2)

○ 4-6 times (3)

○ 7 or more times (4)

Q16 How many times a week do you cook your own meals?

- ○ 0 times (1)
- ○ 1-3 times (2)
- ○ 4-6 times (3)
- ○ 7 or more times (4)

Q17 How many times a week do you cook with other people?

- ○ 0 times (1)
- ○ 1-3 times (2)
- ○ 4-6 times (3)
- ○ 7 or more times (4)

Q18 How would you rate your diet quality?

- ○ Very unhealthy (1)
- ○ Unhealthy (2)
- ○ Neither unhealthy nor healthy (3)
- ○ Healthy (4)
- ○ Very healthy (5)

Q19 Please indicate how easy or difficult it was to understand the previous questions on this page.

- ○ Very difficult (1)
- ○ Difficult (2)
- ○ Neither difficult nor easy (3)
- ○ Easy (4)
- ○ Very Easy (5)

Q20 Please explain what could have made these questions easier to understand.

_____

Please indicate how much you agree with the following statements

Q21 Medical school will adequately educate me in nutrition.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Q22 Medical school will adequately train me in nutrition counseling.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Q23 I can adequately provide nutrition counseling.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Q24 I plan to discuss cooking at-home meals with my future patients.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Q25 Please indicate how easy or difficult it was to understand the previous questions on this page.

- ○ Very difficult (1)
- ○ Difficult (2)
- ○ Neither difficult nor easy (3)
- ○ Easy (4)
- ○ Very Easy (5)

Q26 Please explain what could have made these questions easier to understand.

_____

Please indicate how much you agree with the following statements.

Q27 Nutrition is important in the medical field.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Q28 Nutrition will be important in my intended practice.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Q29 Nutrition is relevant in the medical field.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Q30 Nutrition will be relevant in my intended practice.

- ○ Strongly disagree (1)

- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Q31 Nutrition is important for preventing chronic disease.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Q32 Nutrition is important for treating chronic disease.

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)

Q33 Please indicate how easy or difficult it was to understand the previous questions on this page.

- ○ Very difficult (1)
- ○ Difficult (2)
- ○ Neither difficult nor easy (3)
- ○ Easy (4)
- ○ Very Easy (5)

Q34 Please explain what could have made these questions easier to understand.

_____

Qualtrics Survey Link:
https://asuhealthpromotion.co1.qualtrics.com/jfe/form/SV_4VEcKu9DBzm0AXr