KNOWLEDGE AND BELIEFS OF FUNCTIONAL MEDICINE AND INTEGRATIVE
AND FUNCTIONAL NUTRITION OF ADULTS WITH AND WITHOUT DIABETES

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As the incidence rates of diabetes progress, a change in the treatment approach may be necessary. Functional medicine (FM) and integrative and functional nutrition (IFN) are processes that recognize the genetic and environmental differences in each individual, addressing the "root cause" of a disease. Several studies have explored the effects of functional interventions on diabetic patients, but there is little evidence to show how often these practices are used and accepted by healthcare professionals and individuals with diabetes. The purpose of this study is to investigate the current knowledge and beliefs, along with utilization of the various practices of FM and IFN among faculty and staff with or without diabetes mellitus at Kent State University. Participants were faculty and staff residing at KSU who completed a survey containing of five parts: (1) a researcher developed knowledge of FM/IFN questionnaire, (2) the complementary and alternative medicine health belief questionnaire (CHBQ), (3) a researcher developed utilization of FM/IFN, and (4) a set of demographic questions. The current study found no significance between the knowledge of FM/IFN and the CHBQ scores between those with and without diabetes. Also, the majority of participants who completed this survey had never heard of FM/IFN before and are generally unsure if it can help to treat chronic disease but were interested in learning more. In addition, the

most common supplements taken by the participants were multivitamins, vitamin D, calcium, and magnesium. In the majority of the participants, no herbal supplements were used regularly. The findings of this study support the need for more public education in regard to FM/IFN. With the increased interest for FM/IFN in today's society, healthcare professionals must first be educated on these practices so that they are more comfortable and confident in discussing them with their patients.

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CHAPTER I

INTRODUCTION

Diabetes Mellitus (DM), often referred to as diabetes, is a group of diseases characterized by high blood glucose concentrations resulting from defects in insulin secretion, insulin action, or both. It is one of the top ten leading causes of death in the United States, affecting nearly 34 million people (CDC, 2020). By 2030, it is estimated that diabetes will affect more than 1 in 3 Americans. As the incidence of diabetes continues to rise, so will the associated healthcare costs (Korbel & Spencer, 2015). According to 2012 data by the American Diabetes Association (ADA), about 25% of all inpatient hospital stays are attributed to diabetic patients (Korbel & Spencer, 2015). Also, about half of all physician office visits and emergency department visits are from those suffering from diabetes (Korbel & Spencer, 2015). In 2012, the ADA estimated that diabetes cost the United States $245 billion, with over $120 billion in health services used to manage common complications of diabetes, including end stage renal disease, myocardial infarction, and stroke (Korbel & Spencer, 2015).

In addition to the rising prevalence of diabetes, the number of uninsured people and lack of healthcare coverage is also growing. Many Americans are struggling to pay for common traditional diabetes interventions, like blood sugar lowering medications, insulin injections, and insulin infusion pumps ("Supplement Briefing Discusses Benefits of Functional Medicine", 2010). Medical nutrition therapy (MNT) also plays a huge role in the management of diabetes by helping patients integrate an insulin regimen into their eating and physical activity patterns. Although these interventions may be effective for some, many still do not have a good handle on managing this chronic disease ("Supplement Briefing Discusses Benefits of Functional

Medicine", 2010). In order to address and solve this growing problem, functional medicine may be helpful for this population.

Some aspects of functional medicine may be more cost effective than others, depending on what practice is utilized by an individual. For example, yoga and meditation may come at little to no cost because many people can take advantage of the internet for a free guided practice. On the other hand, other forms like chiropractic care or acupuncture may be more costly. Currently, there is some insurance coverage for alternative therapies, but the prevalence of this type of coverage is nowhere near that of conventional treatments. Although many individuals are interested and open to utilizing functional medicine, most companies are concerned about spending their dollars on healthcare practices that are not shown to be safe and effective. As time goes on, more and more research is needed to evaluate the effectiveness, risks, and benefits of functional medicine.

Functional medicine (FM) and integrative and functional nutrition (IFN) are patient/client-centered approaches that assess an individual's disease as a whole, rather than a set of isolated signs and symptoms (Mahan & Raymond, 2017). These processes recognize the genetic, biochemical, and environmental differences in each individual. FM directly focuses on addressing the "root cause" of an individual's disease and can cover a wide range of alternative inventions, like mind-body therapy, acupuncture, chiropractic medicine, and yoga (The Institute of Functional Medicine, n.d.). In addition, it is not a "one size fits all" approach and mainly determines the "why" behind an illness or disease. Functional medicine specialists build upon the fact that each person has their own unique biochemical makeup and will often carry out environmental or genetic research to determine the additional factors that could play into a patient's health background. In FM, the key to successful treatment is understanding how the

individual can be treated rather than the disease. This type of practice looks to improve a person's overall health in the long term ("Functional Medicine and Integrative Medicine", 2019).

IFN is a nutrition-focused approach of looking at more than just diet when assessing a patient. In this setting, a healthcare professional will take other aspects, like social relationships and environment, into account when providing nutrition recommendations to best meet the patient's needs (Academy of Nutrition and Dietetics, 2019). This approach is an emerging medical nutrition model that "combines the very best of modern science, clinical wisdom, and critical thinking" (Integrative and Functional Nutrition Academy, n.d.). Its main focus is to identify the root causes or imbalances related to a specific disease in order to significantly improve patient outcomes. In this approach, a healthcare professional will create a personalized nutrition plan that may include therapeutic meal plans, mind and body practices, dietary supplements, and lab values (Integrative and Functional Nutrition Academy, n.d.).

Aside from functional medicine, two terms known as "integrative medicine" and "complementary and alternative medicine (CAM)" are commonly referred to as well. These two terms have similar meanings and are often used interchangeably. This is because both terms focus on the "how" and "what" of a disease or illness. Integrative medicine refers to combining treatments from conventional medicine and alternative medicine, while CAM refers to a diverse group of medical and health care practices that can be either complementary or alternative to conventional medicine to aid in the patient's treatment process (Complementary Medicine Education and Outcomes Program, n.d.). They seek to restore and maintain health and wellness across a person's lifespan and go beyond the treatment of symptoms to address all the causes of an illness. Examples of these types of practices include diet therapy, herbalism, biofeedback, acupuncture, yoga, and more.

Diabetes, especially Type 2 DM, is a complicated metabolic disorder with both short- and long-term complications that affect one's quality of life, such as retinopathy, nephropathy, and neuropathy (Chaiopanont, 2008). In addition, illnesses like hypertension, dyslipidemia, coronary heart disease, obesity, and metabolic syndrome are commonly associated with those suffering from diabetes. Several studies have explored the effects of functional interventions on diabetic patients, like dietary supplementation, yoga, meditation, acupuncture, and massage therapy. These interventions have been shown to have protective effects against diabetes, such as glycemic response regulation, increased insulin sensitivity, improved pancreatic beta cell function and insulin secretion (Mahan & Raymond, 2017). In one study, meditation and stress relaxation methods revealed a hypoglycemic effect, decreased blood pressure, and reduced cholesterol levels (Chaiopanont, 2008). In addition, a new functional approach regarding functional foods and their bioactive compounds have been shown to attenuate carbohydrate metabolism and hyperglycemia, regulate lipid/lipoprotein/adipose tissue metabolism, modulate oxidative/antioxidative balance and inflammatory processes, and improve weight management (Mirmiran, Bahadoran, & Azizi, 2014). These interventions may also help to encourage fat redistribution to manage hypercholesterolemia, improve blood circulation to decrease diabetic neuropathy and reduce overall stress in diabetic patients, thus decreasing blood pressure values (Mahan & Raymond, 2017).

Statement of the Problem

In the United States today, DM is the seventh leading cause of death, affecting approximately 34 million men and women with thousands of new cases diagnosed each day (CDC, 2020). The high incidence rate and long-term implications for both health and health care costs make diabetes a top concern for the U.S. (Boyle, Thompson, Gregg, Barker & Williamson,

2010). Recent data reveals that diabetes care cost the U.S. over $245 billion in direct and indirect medical costs and lost productivity (Korbel & Spencer, 2015). This number is expected to continue to rise in the future, specifically affecting middle and older aged adults (Boyle et al., 2010).

Although there are conventional practices set in place to help monitor and manage diabetes, many individuals are now starting to develop an interest in the use of FM/IFN to treat this chronic disease. Current conventional practices for diabetes may include insulin injections or oral medications, regular physical activity, and diet modification (Chang et al., 2007). In addition, diabetes distress is a common condition within this population, affecting nearly 50% of those living with diabetes. Managing diabetes can be very stressful for patients with diabetes, with demands such as testing blood glucose, dosing medications and injections, striving to be consistent with physical activity and food intake, counting carbohydrates, and needing to restrict the foods they enjoy (Rhee, Westberg & Harris, 2017). These practices may be effective; however, they can also be difficult to follow as they may require a drastic lifestyle and behavior change. Thus, adopting a functional approach in addition to conventional interventions may be beneficial among individuals with this disease.

In a 2018 study, researchers asked participants to identify their usage of CAM methods, reasons for CAM use, and overall perceived benefits of CAM (Rhee, Westberg & Harris, 2017). They found that of all diabetic patients using CAM methods, 15.0% used CAM for treatment alone to improve sports performance or memory, 28.3% used CAM for wellness alone to enhance immune function, and 56.7% reported using CAM methods for a combination of both treatment and wellness (Rhee, Westberg & Harris, 2017). The results showed that chiropractic care was the most common type of CAM used for treatment, while herbal therapies were the

most common type of CAM used for wellness. They determined that those who reported using

CAM for a combination of treatment and wellness had a twofold higher "better sense of control

over their health" and "improved overall health and feeling better" than those who used CAM for

treatment only (Rhee, Westberg & Harris, 2017). Overall, these findings may represent a proxy

for health-related quality of life and may provide clinical implications. Since roughly one-third

of adults with diabetes use CAM, healthcare providers should understand and discuss the reasons

for and perceived benefits of CAM use with their patients (Rhee, Westberg & Harris, 2017).

Another component to herbal therapies is the utilization of functional foods. Functional

foods contain biologically active ingredients associated with physiological health benefits for

preventing and managing Type 2 diabetes (Alkhatib et al., 2017). Components of the

Mediterranean diet, like fruits, vegetables, fish, olive oil, and tree nuts serve as a model for

functional foods due to their high nutraceutical content (Alkhatib et al., 2017). In addition,

functional foods may be associated with increased antioxidant, anti-inflammatory, and anti-

cholesterol properties, along with an enhanced insulin sensitivity (Alkhatib et al., 2017).

Although there is sufficient evidence to support the use of functional foods as a major factor in

the prevention of Type 2 diabetes, there is little evidence to show how often these practices are

used and accepted by both healthcare professionals and individuals with diabetes. The gathering

of this data will allow for a better understanding of the interest in functional practices along with

the overall need for refined diabetic prevention and treatment plans.

Purpose Statement

The purpose of this study is to investigate the current knowledge and beliefs, along with

utilization of the various practices of functional medicine (FM) and integrative and functional

nutrition (IFN) among adults with or without diabetes mellitus.

Hypotheses

H$_1$: There will be a significant difference in knowledge of FM and IFN between individuals with and without Diabetes Mellitus.

H$_2$: There will be a significant difference in health beliefs (score on CHBQ) of FM and IFN between individuals with and without Diabetes Mellitus.

Research Questions

1). What proportion of adults have heard of FM and IFN?

2). Do individuals believe FM and IFN practices are effective for Diabetes Mellitus?

3). What is the occurrence of FM/IFN related supplement use in adults?

4). What proportion of adults have discussed nutrigenomics with a health provider?

5). What CAM or FM/IFN methods have adults used to treat chronic disease?

Operational Definitions

Functional Medicine: *a holistic approach to treating disease that investigates the "root cause" of the problems instead of finding ways to alleviate the patients' symptoms*
Other terms: complementary alternative medicine, integrative medicine

Integrative and Functional Nutrition: *a practice that provides nutrition recommendations based on an evaluation of an individual's specific needs and goals which are determined by physical, mental, emotional and environmental factors*

Conventional Medicine: *the methods of treating disease used by medical doctors, nurses, psychologists, and similar healthcare professionals*
Other terms: Biomedicine, allopathic medicine, western medicine, mainstream medicine, orthodox medicine

Nutrigenomics: *the study of the interaction between nutrition and genes*

Functional Medicine Knowledge: *refers to knowledge of concepts and processes related to Functional Medicine*

Health Beliefs: *overall beliefs, perceived benefits of action, and potential barriers to action in any health-promoting behavior*

Diabetes Mellitus: *a disease in which the body's ability to produce or respond to the hormone insulin is impaired, resulting in abnormal metabolism of carbohydrates and elevated levels of glucose in the blood and urine*

CHAPTER II

REVIEW OF LITERATURE

United States Prevalence of Diabetes Mellitus

In 2019, approximately 34 million Americans were diagnosed with DM, which equates to 1 in 10 people (CDC, 2020). In adults, Type 1 DM accounts for about 5-10% of all diagnosed cases, Type 2 DM accounts for roughly 90-95% of all diagnosed cases, and 1 in 5 people go undiagnosed (CDC, 2020). The prevalence of this chronic disease increases with age, affecting 1.5 million people 18 years or older (CDC, 2020). In Type 2 DM, the prevalence is the highest in ethnic groups, particularly American Indians and Alaska Natives, non-Hispanic blacks, Hispanics, and Asian Americans (Mahan & Raymond, 2017).

One of the top concerns in our nation today is the rising numbers of those with prediabetes (Mahan & Raymond, 2017). Prediabetes is categorized when impaired glucose homeostasis is present including impaired glucose tolerance and impaired fasting glucose. Individuals experiencing prediabetes are at a higher risk for development of Type 2 DM and CVD. Currently, there are 86 million people with prediabetes, 37% of which are adults aged 20 years or older and 51% aged 60 years or older (Mahan & Raymond, 2017).

Types of Diabetes Mellitus

Diabetes Mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from a defect in insulin secretion, insulin action, or both ("Diagnosis and Classification of Diabetes Mellitus", 2004). Chronic hyperglycemia is associated with long-term damage, dysfunction, and organ failure. The diagnostic criteria for diabetes is based on either Hemoglobin A1C (HbA1c) or plasma glucose values, either fasting plasma glucose (FPG) or the 2-hour plasma glucose (2-h PG). A HbA1c test measures the amount of blood sugar attached to

hemoglobin, which is the part of your red blood cells that carries oxygen from your lungs to the rest of your body. An HbA1c value $\geq$ 6.5%, FBG $\geq$ 126 mg/dL, or 2-h PG $\geq$ 200 mg/dL indicates the presence of diabetes ("Classification and Diagnosis of Diabetes", 2016). If a patient is experiencing hyperglycemia, a random plasma glucose $\geq$ 200 mg/dL may be used to diagnose the disease as well ("Classification and Diagnosis of Diabetes", 2016).

Diabetes screening should be considered for all overweight adults, especially with those who have one or more additional risk factors. In adults without any additional risk factors, testing should begin at 45 years of age and should be administered in three-year intervals. Additional risk factors for this disease include physical inactivity, a family history of diabetes in a first-degree relative, members of high risk populations (African American, Latino, Native American, Asian American, and Pacific Islander), and women who have been diagnosed with gestational diabetes or have a baby weighing more than nine pounds (Mahan & Raymond, 2017). Other risk factors can include having hypertension, dyslipidemia, polycystic ovary syndrome (PCOS), or cardiovascular disease ("Classification and Diagnosis of Diabetes", 2016).

Type 1 Diabetes Mellitus

Type 1 DM accounts for only 5-10% of those with diabetes and may also be known as "insulin-dependent diabetes" or "juvenile-onset diabetes" (Atkinson & Eisenbarth, 2001). Type 1 DM has two forms: immune mediated and idiopathic. The immune mediated form is most common and results from the body's immune system damaging the beta cells in the pancreas (Cedars-Sinai, n.d.). The idiopathic form refers to the form that has no known etiology or treatment (Cedars-Sinai, n.d.).

Pathophysiology/Symptoms

There are numerous markers of the immune destruction of the beta-cells, including islet cell antibodies, autoantibodies to insulin, autoantibodies to glutamic acid decarboxylase (GAD65), and autoantibodies to the tyrosine phosphates IA-2 and IA-2beta (Mahan & Raymond, 2017). Typically, one or more of these antibodies are present in about 85-90% of individuals when fasting hyperglycemia is first detected. There are also strong genetic factors associated with this disease, such as, the linkage between the histocompatibility locus antigen (HLA) and the DQA and DQB genes. These HLA-DR/DQ alleles can be either predisposing or protective. The rate of beta-cell destruction may be rapid in some individuals (infants and children) and slow in others (adults). Hyperglycemia and other symptoms develop after 90% or more of the secretory capacity of the beta-cell mass is destroyed. After the diagnosis and correction of hyperglycemia, endogenous insulin secretion usually recovers and exogenous insulin requirements decrease significantly for up to a year or longer, thus one can easily achieve metabolic control during this time (Mahan & Raymond, 2017).

Type 1 DM is an amylin-deficient state. Amylin is a glucoregulatory hormone that is produced in the pancreatic beta-cell and co-secreted with insulin (Mahan & Raymond, 2017). It regulates postprandial glucose levels and suppresses glucagon secretion, complementing the effects of insulin. Those with Type 1 DM are more prone to autoimmune disorders, like celiac disease, Graves' disease, and Hashimoto's thyroiditis. In addition, latent autoimmune diabetes of aging (LADA) may account for as many as 10% of cases of insulin-requiring diabetes in older adults.

The most common symptoms of Type 1 DM include hyperglycemia, excessive thirst, frequent urination, significant weight loss, and electrolyte disturbances. The symptoms can lead

to other complications within the body, such as ketoacidosis, macrovascular diseases, microvascular diseases, and neuropathy (Mahan & Raymond, 2017).

Conventional Treatment of Type 1 DM

The treatment and management of Type 1 DM includes the use of both medical management and medical nutrition therapy (MNT). Medical management includes the use of medications, like insulin by injection or insulin infusion pumps. Individuals must also monitor their blood glucose levels and are responsible for getting their values for A1C, lipids, blood pressure, and ketones assessed and evaluated (American Diabetes Association, 2011). As for MNT, it is crucial to integrate an insulin regimen into an individual's eating and physical activity schedule. There must be consistency in the timing and amount of carbohydrates eaten if a person is on fixed insulin doses. On the other hand, a premeal insulin dose is based on insulin-to-carbohydrate ratios. With this type of insulin, an individual must be aware of how to count carbohydrates in order to give themselves the proper dose. Other nutrition related treatments include controlling energy intake to prevent additional weight gain and cardioprotective nutrition interventions (American Diabetes Association, 2011).

Type 2 Diabetes Mellitus

Type 2 DM accounts for around 90% of all diagnosed cases of diabetes and is often present before it is diagnosed (Goyal & Jialal, 2020). Hyperglycemia develops slowly and is usually unnoticeable in the early stages, due to the lack of symptoms present. Individuals with Type 2 DM have an increased risk of developing macrovascular and microvascular complications and are typically overweight or obese. Researchers have studied the effects of obesity on the presence of Type 2 DM and have found that obesity already causes some degree of insulin resistance, yet most obese individuals are not suffering from diabetes. Thus, obesity

paired with genetic predisposition may be necessary for Type 2 DM to occur. Other risk factors include various genetic and environmental factors, such as older age, physical inactivity, or a family history of gestational diabetes, prediabetes, hypertension, or dyslipidemia (Goyal & Jialal, 2020).

Pathophysiology/Symptoms

Type 2 DM is characterized by an impaired insulin response to glucose in pancreatic beta cells. In diabetic patients, the acute phase of insulin response is often reduced or even non-existent (Ostenson, 2001). Insulin resistance is first seen in target tissues-- mainly the muscle, liver, and adipose cells. First, there is an increase in insulin secretion, which mimics a normal or pre-diabetic glucose range (Mahan & Raymond, 2017). The pancreas is unable to continue the production of insulin, thus hyperglycemia occurs and diabetes is diagnosed. Hyperglycemia is first displayed as an elevation of postprandial blood glucose caused by insulin resistance at the cellular level, followed by an increase in fasting blood glucose concentration. The fasting blood glucose starts to rise due to the decrease in insulin secretion and the increase in hepatic glucose production. The insulin response also does a poor job of suppressing alpha-cell glucagon secretion, resulting in glucagon hypersecretion and increased hepatic glucose production (Mahan & Raymond, 2017). In addition, insulin resistance can also lead to lipolysis or an increase in the circulation of free fatty acids. By increasing the amount of fatty acids, there will be a further decrease in insulin sensitivity at the cellular level, impaired pancreatic insulin secretion, and an increase in lipotoxicity, which in turn will contribute to the progression of the disease (Mahan & Raymond, 2017).

Common symptoms of Type 2 DM include hyperglycemia, fatigue, excessive thirst, and frequent urination (Mahan & Raymond, 2017). The clinical findings associated with this type of

diabetes include abnormal insulin action and secretion, decreased cellular uptake of glucose, increased postprandial glucose, and increased gluconeogenesis. In addition, central obesity, hypertension, and dyslipidemia are typical within this population.

Conventional Treatment of Type 2 DM

Due to the fact that Type 2 DM is significantly related to lifestyle routine, much of the MNT for this type is focused on diet and exercise. By improving an individual's quality of life through nutrition and physical activity, one can improve their glycemia, dyslipidemia, and blood pressure readings (American Diabetes Association, 2011). Nutrition counseling and education, such as carbohydrate counting and caloric restriction, may help an individual prevent any additional weight gain. Some individuals may need a combination of different diabetes medications and insulin therapy to control their blood glucose (American Diabetes Association, 2011).

Gestational Diabetes Mellitus

Gestational DM occurs in roughly 7% of all pregnancies, resulting in over 200,000 cases a year (Mahan & Raymond, 2017). After delivery, 90% of all women with GDM become normoglycemic, but are at a higher risk of developing GDM earlier in their following pregnancies. In addition, about 5-10% of women with GDM are diagnosed with Type 2 DM right after pregnancy. These women also have a 35-60% chance of developing diabetes within the next 5 to 10 years. Lifestyle modifications, such as physical activity, may aid in reducing the risk of developing diabetes after pregnancy. All women should be screened for GDM at 24-28 weeks of gestation. GDM is often diagnosed in the second or third trimester due to the increase in insulin-antagonist hormone levels and insulin resistance normally occurring during this time. GDM screening may be accomplished in two ways. The first way to diagnose GDM is a one-

step 3-hour oral glucose tolerance test (OGTT). After an 8 hour fast, blood will be drawn and a

liquid containing glucose will be administered to the patient. Blood will then continue to be

drawn every hour for a few hours. A FBG >92 mg/dL, a 1-hour >180 mg/dL, or a 2-hour >153

mg/dL is the criteria for GDM. The other approach is called the two-step approach. In this

approach, the patient does not need to fast and undergoes a 1-hour 50-g screen followed by a 3-

hour 100-g OGTT if the plasma glucose ≥140 mg/dL. The diagnosis of GDM is confirmed when

the plasma glucose level after 2 hours is ≥ 140mg/dL (Mahan & Raymond, 2017).

Pathophysiology/Symptoms

The primary metabolic changes in GDM include insulin deficiency due to beta-cell

destruction and insulin resistance (Harlev & Wiznitzer, 2010). These changes are identical to the

process that occurs in the prediabetes stage in Type 2 DM. They not only affect the pancreas,

but also the process of gluconeogenesis as well. During this time, gluconeogenesis is increased

as a result of hepatic insulin resistance and relative insulin deficiency, thus affecting

hyperglycemia. Recent research has been conducted to further investigate the path of metabolic

changes in those with GDM (Harlev & Wiznitzer, 2010).

Investigators first focused on the relationship between genetics and GDM. They found

that women with GDM had the lowest tyrosine phosphorylation of the insulin receptor, when

compared with pregnant women without GDM (Harlev & Wiznitzer, 2010). In addition, they

noted that this finding was unrelated to any changes in the abundance of the insulin receptor.

Researchers concluded that insulin resistance to glucose transport during pregnancy is associated

with a decrease in IRS-1 tyrosine phosphorylation, primarily due to decreased expression of IRS-

1 protein. In those with GDM, a decrease in tyrosine phosphorylation of the insulin receptor beta

subunit is associated with further decreases in glucose transport (Harlev & Wiznitzer, 2010).

Another component that may be involved in the pathophysiology of GDM is adiponectin (Abell, Courten, Boyle & Teede, 2015). Adiponectin is an abundant plasma protein secreted from adipose tissue and is typically decreased in obesity. Adiponectin is an insulin-sensitizing, anti-inflammatory, and anti-atherogenic adipokine that stimulates glucose uptake in the skeletal muscles. In addition, it reduces hepatic glucose production through AMP-activated protein kinases. In normal pregnancy, adiponectin secretion starts to decline, creating insulin resistance and correlating with beta-cell dysfunction. This down-regulation of adiponectin may predict GDM in pregnant women. Evidence shows that women with lower first trimester adiponectin have an increased risk of developing GDM. Adiponectin may also decrease fetal growth by impairing placental insulin signaling and reducing insulin-stimulated amino acid transport. Hypoadiponectinemia may continue postpartum in those with GDM, possibly contributing to the progression of Type 2 DM (Abell et al., 2015).

Conventional Treatment of Gestational DM

For women with GDM, scheduled physical activity and eating plan adjustments are necessary to control blood glucose levels. It is important to set plasma glucose goals during pregnancy to not only manage the effects of GDM, but also to ensure adequate nutrition for both the mother and fetus (Mahan & Raymond, 2017). The plasma glucose goals for those with GDM include a pre-prandial reading of ≤95 mg/dL or 1-hour post-meal ≤140 mg/dL or 2-hour post-meal ≤120 mg/dL. For those with pre-existing Type 1 or Type 2 DM, a pre-meal, bedtime, and overnight glucose reading of 60-99 mg/dL, peak postprandial glucose of 100-129 mg/dL and a A1C level <6.0 % are ideal. The MNT for GDM includes a carbohydrate-controlled meal plan to provide optimal nutrition and appropriate weight gain. A controlled meal plan can also help a GDM patient to achieve and maintain normoglycemia and encourage the absence of ketosis. If

glucose goals exceed target ranges on two or more occasions within a 1-2 week time frame, insulin, metformin, or glyburide therapy may be added. Adequate exercise can also aid in overcoming peripheral resistance to insulin and assist in controlling fasting and postprandial hyperglycemia (Mahan & Raymond, 2017).

Less Common Types of Diabetes Mellitus

Although type 1, type 2, and gestational DM make up the majority of all cases, there are other more uncommon types of diabetes. These types include latent autoimmune diabetes in adults, monogenic diabetes, brittle diabetes, and cystic fibrosis related diabetes. These various types account for 1-5% of all diagnosed cases ("Forms Of Diabetes", n.d.).

Latent Autoimmune Diabetes in Adults (LADA)

LADA is an adult-onset, slowly progressive form of diabetes, also known as type 1.5 DM (Laugesen, Ostergaard, & Leslie, 2015). Although this type shares genetic features with both type 1 DM and type 2 DM, it's commonly misdiagnosed for type 2 DM due to the nature of the disease (Laugesen, Ostergaard, & Leslie 2015). Despite the presence of islet antibodies, the progression of autoimmune beta cell failure is slow (Strenstrom, Gottsater, Bakhtadze, Berger, & Sundkvist, 2005). Numerous studies indicate that LADA patients with multiple islet antibodies develop beta cell failure within 5 years, while those with only GAD antibodies (GADAs) or islet cell antibodies (ICAs) typically develop beta cell failure after 5 years (Strenstrom et al., 2005). Although it may take a significant amount of time, damage to the beta cell response in glucose and glucagon can be detected at the initial diagnosis of LADA (Laugesen, Ostergaard, & Leslie, 2015). LADA patients do not require insulin originally but will begin to become more insulin dependent as beta cell function decreases over time. There are currently no specific guidelines for treatment of LADA, thus patients are mostly treated the same as those with Type 2 DM. The

correct therapeutic strategy for LADA patients should aim to preserve beta cell function and improve glucometabolic control, in order to reduce the risk of long-term complications (Pozzilli & Pieralice, 2018). Common interventions may include the use of sulphonylureas, insulin therapy, and dipeptidyl peptidase 4 (DPP-4) inhibitors (Pozzilli & Pieralice, 2018).

Monogenic Diabetes

Monogenic diabetes is a rare type of diabetes that is commonly inherited, resulting from mutations in genes involved in beta cell development and insulin secretion. ("Monogenic Diabetes", 2017). There are two main forms of monogenic diabetes, neonatal diabetes and maturity onset diabetes of the young (MODY). Neonatal diabetes is typically diagnosed in infants within the first six months of age and has been linked to at least 25 genetic causes (Yeung, Hannah-Shmouni, Niederhoffer, & Walker, 2018). For these patients, oral sulfonylurea therapy is typically used. Children suffering from neonatal diabetes may develop a variety of neurodevelopmental issues, such as autism or attention deficit hyperactivity disorder (ADHD) (Yeung et al., 2018).

Next, MODY is a form that is diagnosed typically before 25 years of age (Yeung et al., 2018). As researchers continue to study MODY, they've determined that there are various genes affected with this form of diabetes. One of the most common forms is the defect in the glucokinase (GCK) gene, which encodes glucokinase. Glucokinase is the enzyme that catalyzes the conversion of glucose to glucose-6-phosphate in glucose metabolism and insulin secretion. Researchers have concluded that there are over 620 mutations in GCK, which are all associated in the overall development of MODY (Yeung et al., 2018). The treatment depends on the gene affected, as some people do not require any treatment other than diet and exercise while others are prescribed medication. One of the most characteristic features of MODY includes the

sensitivity to sulfonylureas, which is typically the first-line treatment (Sanyoura, Philipson, &

Naylor, 2018). Other treatment options include basal insulin, meglitinides, or glucagon-like

peptide-1 (GLP-1) receptor agonists (Sanyoura, Philipson, & Naylor, 2018).

Brittle Diabetes

Brittle DM is a form of insulin dependent diabetes and is categorized by severe glycemic

instability (Pelizza & Pupo, 2016). This type affects 3 per 1000 insulin-treated diabetics and is

most frequently seen in those who are of a younger age, female, and overweight/obese. In

addition, having a shorter diabetes duration, higher insulin dose, and insulin resistance has been

correlated to brittle DM (Pelizza & Pupo, 2016). Researchers suspect that the main underlying

cause for this type of diabetes is a psychological disturbance, like anorexia, depression, or

anxiety (Pelizza & Pupo, 2016). As one of the main concerns of brittle diabetes is unpredictable

rises and drops in blood sugar, a limited carbohydrate diet is suggested to make these

fluctuations less severe ("Brittle Diabetes", 2019). Due to unstable blood sugar levels, patients

are most often hospitalized and require frequent utilization of an insulin pump or a glucose

monitoring device. In addition, clinicians also recommend using mindfulness-based therapies to

address any underlying feelings of stress or anxiety.

More recently, motivational interviewing (MI) has become a popular form of treatment

for those suffering from Brittle DM. In MI, the counselor aims to awaken the patient's

motivation to change through assisting them in creating goals, values, and aspirations (Harvey,

2015). In one meta-analysis of MI, significant effects were seen on weight, cholesterol, blood

pressure, and alcohol consumption (Harvey, 2015). In addition, cognitive behavioral therapy

(CBT) may also be used as a form of treatment and intervention in these patients. In CBT, the

therapist challenges the patient's negative thoughts and helps them to identify the coping skills

needed to generate a positive approach to behavior change (Harvey, 2015). In a four-week pilot study, research showed that CBT helped DM patients overcome negative beliefs and attitudes toward diabetes, thus improving self-care behavior (Harvey, 2015). In addition, researchers noted that HbA1C was 0.8% lower at 6 months and was more effective in combination with MI (Harvey, 2015).

Cystic Fibrosis Related Diabetes (CFRD)

The pancreas is histologically abnormal in many of those suffering from cystic fibrosis (CF). Although not everyone with cystic fibrosis develops diabetes, the mechanisms of CFRD include reduced and delayed insulin secretion, increased insulin resistance, and alterations in the regulation of the enteroinsular axis (Brennan & Beynon, 2015). Alterations in the enteroinsular axis hormone, glucagon-like peptide 1 (GLP-1), are released in response to the ingestion of nutrients and work by stimulating insulin and inhibiting glucagon. Researchers suggest that this hormone may play an active role in the etiology of this form of diabetes. In human studies, researchers have determined that GLP-1 levels are lower in CF and CFRD patients. By slowing gastric emptying and increasing hormone secretion, pancreatic enzyme supplementation may help to overall reduce postprandial hyperglycemia (Brennan & Beynon, 2015). The treatment for CFRD includes the normalization of blood glucose, which should be achieved by balancing insulin requirements with adequate energy intake. Insulin is the only current treatment for CFRD recommended by guidelines as there is an inadequate amount of data available for other therapies at this time (Ode et al., 2019). In addition, the CF Foundation recommends that patients inject short-acting insulin before each meal with a small dose of long-acting insulin at night (Brennan & Beynon, 2015).

Treatment of Diabetes Mellitus

There are a variety of ways to manage diabetes, including both conventional and functional approaches.

Conventional Medicine

Conventional medicine is the type of practice that most Americans are familiar with. It is usually practiced by holders of M.D. (medical doctor) and D.O. (Doctor of Osteopathic Medicine) degrees and their allied healthcare professionals such as physical therapists, psychologists and registered nurses ("Conventional Medicine", n.d.). Conventional medicine may also be known as western, allopathic, or modern medicine. When it comes to conventional medicine, symptoms are addressed with drugs or surgery and the associated treatment is primarily based on research, lab values, and clinical trials. Conventional medicine is currently the most accepted approach in the United States, but it severely lacks individualistic treatment ("Conventional Medicine", n.d.).

Conventional medicine excels in the areas of testing and diagnostics ("Western Medicine", n.d.). Physicians practicing this type of medicine make decisions about which treatment will be most helpful to their patients based on controlled, scientific studies. These treatment plans may include prescription medication, surgery, infusions, and other conventional procedures and therapies. One reason that many Americans may adopt these common practices and treatment plans could be due to the way the U.S. healthcare system is run. American individuals receive health care coverage through private employer-sponsored or individual health care plans, thus they are more likely to utilize these conventional services opposed to functional practices (like acupuncture, herbal supplementation, and massage therapy) that remain uncovered by most health insurance companies ("Western Medicine", n.d.).

Use of Conventional Medicine

As discussed before, the prevalence of conventional medicine is popular and heavily utilized in the United States. In 2017, data from the Center for Disease Control and Prevention (CDC) revealed that 48.4% of Americans have used one prescription drug in the past 30 days, 24% have used three or more and 12.6% have used five or more ("Therapeutic Drug Use", 2017). At physician office visits, there were 2.9 billion drugs ordered or provided and about 74% of all visits involved some type of drug therapy.

The use of conventional medicine, especially prescription drugs, is a major expenditure in the U.S. and studies suggest it is increasing (Kantor, Rehm, Haas, Chan & Giovannucci, 2015). Researchers estimated the prevalence of prescription drug use from 1999-2000 to 2011-2012 by evaluating representative data from the National Health and Nutrition Examination Survey (NHANES). Overall, they found that prescription drug use increased among U.S. adults during this time frame. The prevalence of prescription drug use increased by 8% while the prevalence of polypharmacy increased by nearly 7%. In addition, the use of antihypertensive, antihyperlipidemics, and antidepressant drugs increased over the study period. As the prevalence of diabetes increased, the use of antidiabetic drugs (specifically metformin) also significantly increased. The increases in prescription drug use and polypharmacy among adults of all ages may be explained by the large-scale policy changes, including the drug coverage policies associated with Medicare (Kantor et al., 2015).

Conventional Interventions for Diabetes

As the prevalence of diabetes increases, health care professionals are utilizing various interventions to manage and prevent this chronic disease. To prevent and decrease the risk of diabetes, many doctors and dietitians are suggesting individuals to consume a balanced diet and

adhere to a consistent exercise regimen. To manage diabetes, doctors typically prescribe insulin injections or oral medications.

Insulin Injections. The use of insulin is often part of the treatment for all types of diabetes, along with healthy food choices and exercise. For Type 1 DM patients, insulin injections are the most common form of treatment, simply because the body cannot make this hormone on its own ("Insulin, Medicines, & Other Diabetes Treatments", 2016). Depending on the severity of the disease, those with Type 2 DM and GDM may also require insulin injections. There are various types of insulin available, each one with a different onset time and duration. For example, rapid-acting insulin starts to work after 15 minutes of injection and lasts for 2-4 hours while short-acting (or regular) insulin has an onset time of 30 minutes and lasts for 3-6 hours. Intermediate-acting insulin starts to have an effect in 2-4 hours after injection and may last for 12-18 hours, and long-acting insulin may take effect several hours after injection and last for up to 24 hours ("Insulin, Medicines, & Other Diabetes Treatments", 2016).

Insulin can be taken in many ways, depending on lifestyle factors, insurance plans, and preferences ("Insulin, Medicines, & Other Diabetes Treatments", 2016). Some diabetics give themselves doses of insulin via syringes and insulin pens. Additionally, many individuals utilize an insulin pump, which connects to a small plastic tube and needle and penetrates the skin. The insulin pump can give multiple doses throughout the day and is ideal to have during mealtimes. Another less common, but effective way to take insulin is by an inhaler. Adults with Type 1 or Type 2 DM can breathe in powdered insulin that will go into their lungs and move quickly into the bloodstream ("Insulin, Medicines, & Other Diabetes Treatments", 2016).

Diet. Nutritional recommendations and interventions are necessary in the treatment and management of this chronic disease. Specific dietary recommendations can aid in reaching the

patient's desired blood glucose, blood pressure, lipid profile and weight (Marin-Penalver, Martin-Timon, Sevillano-Collantes & Canizo-Gomez, 2016). In addition, an improvement in sleep apnea, depression, urinary incontinence and overall quality of life can also be seen with dietary changes (Marin-Penalver, Martin-Timon, Sevillano-Collantes & Canizo-Gomez, 2016). In most cases, type 2 DM patients are categorized as overweight or obese due to insulin resistance or a defect in insulin secretion. To combat this, dietitians typically prescribe a diet that encourages a caloric intake calculated for weight loss and balanced macronutrient distribution. The amount and type of carbohydrates consumed are the main determinants for glycemic control, thus counting carbohydrates has been shown to be crucial in the management of all diabetes (Marin-Penalver, Martin-Timon, Sevillano-Collantes & Canizo-Gomez, 2016).

As for protein, some studies demonstrate that if 28-40% of the total calories are from protein sources, there is an improvement of HbA1c, triglycerides, total cholesterol, and/or LDL cholesterol (Marin-Penalver, Martin-Timon, Sevillano-Collantes & Canizo-Gomez, 2016). An adequate protein intake also may reveal an increase in the insulin response with type 2 DM patients. Although there are few studies about the consumption of saturated fatty acids in diabetic patients, it has been proven that the consumption of monounsaturated fatty acids can improve cardiovascular risk factors and glycemic control, especially if they are replacing the consumption of saturated fatty acids (Marin-Penalver, Martin-Timon, Sevillano-Collantes & Canizo-Gomez, 2016).

Exercise. Exercise has an extremely beneficial effect on metabolic parameters affecting cardiovascular risk, like lipids and blood glucose (Lumb, 2014). Glycemic control improves with both aerobic and resistance exercise in type 2 diabetes, but no glycemic benefit is seen in type 1 (Lumb, 2014). Data from a recent meta-analysis revealed that a structured exercise

regimen was related to a decrease in HbA1c, with the most benefit resulting from a combination

of both aerobic and resistance training. Based on *The American Diabetes Association Standards*

for Diabetes Care, adults with diabetes should be exercising for at least 150 minutes per week of

moderate-intensity aerobic physical activity (50-70% of maximum heart rate) spread over 3 days

per week with no more than 2 consecutive days without exercise (Lumb, 2014). In addition,

resistance training should occur at least twice per week. Common barriers to exercise in diabetic

patients include the likelihood of both hypoglycemia and hyperglycemia. During aerobic or high

intensity exercise, a rapid drop in blood glucose may occur due to the suppression of metabolic

fuel production and an increase of glucose into the muscles, causing hypoglycemia (Lumb,

2014). On the other hand, anaerobic exercise can predispose an individual to hyperglycemia as

metabolic fuel production is driven by changes in circulating hormone levels and a rise in

catecholamines (Lumb, 2014). To avoid hypoglycemia and hyperglycemia, healthcare

professionals recommend reducing doses and/or increasing energy intake (usually carbohydrates)

before or during exercise (Lumb, 2014).

  Oral Medications. In addition to diet and exercise, oral medications can be used to lower

blood sugar levels, release insulin and help improve HbA1C levels. These oral hypoglycemics

are prescribed to suppress glucose production in the liver and increase insulin sensitivity in

tissues (Morges & Otero, 2014). In severe cases, insulin can be injected with specific meal and

dosage times. Common diabetic drugs include alpha-glucosidase inhibitors, biguanides, bile acid

sequestrants (BASs), dopamine-2 agonists, DPP-4 inhibitors, meglitinides, sodium glucose

transporter 2 (SGLT2) inhibitors, sulfonylureas, thiazolidinediones (TZDs) and oral combination

therapy ("What Are My Options?", n.d.).

Acarbose and miglitol are alpha-glucosidase inhibitors that help the body lower blood sugar levels by blocking the breakdown of starches in the intestine. The well-known diabetic drug, Metformin, is a biguanide that lowers blood sugar levels by decreasing the amount of glucose produced by the liver and making muscle tissue more sensitive to insulin so glucose can be absorbed. Next, BASs help remove LDL cholesterol by binding with bile acids in the digestive system, using cholesterol to replace the bile acids. Dopamine-2 agonists help to lower blood sugar after a meal and DPP-4 inhibitors help improve HbA1C without causing hypoglycemia. Similarly, both meglitinides and sulfonylureas stimulate the beta cells to release insulin and must be consumed before meals. SGLT2 inhibitors work in the kidney to reabsorb glucose and cause excess glucose to be excreted in the urine, while TZDs help insulin to work better in the muscle and fat and reduce glucose production in the liver ("What Are My Options?", n.d.).

Oral combination therapy is the simultaneous use of different drugs. Diabetic drugs may be used together because they act in different ways to lower blood sugar levels. Although this method may be more effective, taking more than one drug can be costly and increase the risk of side effects, such as diarrhea, constipation, or urinary tract infections ("What Are My Options?", n.d.).

Advantages of Conventional Medicine The benefits and overall effectiveness of conventional medicine are apparent. Although healthy lifestyle choices provide the foundation for managing Type 2 DM, some individuals may need medications to achieve their target blood glucose levels. One major advantage of conventional practice in relation to diabetes is the use and effectiveness of antihyperglycemic drugs. There are several classes of diabetes medications and each one works in a different way to manage healthy blood glucose levels. The major classes of oral

antidiabetic medications include biguanides, sulfonylureas, meglitinide, thiazolidinedione, dipeptidyl peptidase (DPP-4) inhibitors, sodium-glucose cotransporter inhibitors, and alpha-glucosidase inhibitors (Chaudhury et al., 2017). These drugs may work by stimulating the pancreas to produce and release more insulin, inhibiting the production and release of glucose from the liver, blocking the enzymes that break down carbohydrates, improving insulin sensitivity, inhibiting the reabsorption of glucose in the kidneys, and slowing how quickly food is digested ("Diabetes Treatment", 2018). These drugs have been shown effective as researchers conclude that metformin, a commonly used biguanide, reduces mortality from all causes by nearly 26% (Brooks, 2009).

If antidiabetic drugs are not effective, then a second method of treatment may be added to the regimen, like insulin therapy or glucagon-like peptide-1 receptor agonists (GLP-1 RAs). Insulin helps to regulate blood sugar levels and store excess glucose for energy. Tight glycemic control with intensive insulin therapy has been shown to reduce the risk of the microvascular and macrovascular complications of diabetes (Home et al., 2014). In addition, intensive insulin treatment given to patients in an intensive care unit reduced mortality by roughly 42% (Brooks, 2009). Another common form of treatment is through the use of GLP-1 RAs. GLP-1 RAs are injected under the skin and may delay gastric emptying, increase the production of insulin, and reduce glucagon secretion (Home et al., 2014). Combination therapy of insulin and GLP-1RAs appears effective and may gain the glucose-lowering advantages while managing weight and reducing the risk of hypoglycemia (Home et al., 2014).

Disadvantages of Conventional Medicine

Although there are many advantages of conventional medicine, there is also a significant disadvantage. The major disadvantage of conventional medicine is the rising costs of

medications. Over the past decade, insulin prices have tripled in the US, while out-of-pocket costs per prescription have doubled (Herkert et al., 2019). Between 2010 and 2015, the monthly wholesale price of Humulin, one of the most popular insulins used, rose from $258 to $1100 for the average patient (Herkert et al., 2019). These high costs may be the main contributing factor to patient nonadherence. Researchers have determined that 25% of people are using less insulin than prescribed to save money, and about ⅓ of those patients are not telling their families or physicians that they are taking this risk (Herkert et al., 2019). Patients are cutting pills in half to make them last longer and skipping out on taking their daily medications in order to increase the affordability and longevity of the product.

Researchers have also determined that diabetic individuals born 1965-1980 are living 15 years longer than those born before 1965, due to tight glucose control and precise insulin dosing (Herkert et al., 2019). By not taking the appropriate dose of insulin, individuals have a greater risk of a life-threatening metabolic disturbance, disabilities such as blindness and kidney failure, and premature death. Managing normal glucose levels are vital for a diabetic patient, thus new, cost-effective approaches may be required to ensure these needs are being met.

Functional Medicine

Functional medicine is an evolving, evidence-based approach that views the body with its interactive systems as a whole, rather than a set of isolated signs and symptoms (Mahan, Raymond, 2017, p.118). The Institute of Functional Medicine (IFM) promotes an evaluation process that recognizes the genetic, biochemical, and environmental differences in each individual ("What is Functional Medicine?", n.d.). The focus of this approach is mainly patient-centered, not disease-centered. Thus, typical factors in this practice include nutrition, exercise, adequate sleep, healthy relationships, and a positive-mind-body belief system. There are many

terms that are often used interchangeably with "functional medicine", such as holistic medicine, alternative medicine, complementary medicine, and integrative medicine. Holistic medicine is based on the theory that health is a vital dynamic state and is more than just the absence of disease. Alternative and complementary medicine are types of holistic therapies and are used in place of conventional medicine, and integrative and complementary medicine are used in addition to conventional medicine (Mahan & Raymond, 2017).

The Functional Nutrition Assessment (FNA) approach recognizes the root causes of a disease by integrating traditional dietetic practice with the concept of nutrigenomics, along with the interpretation of nutritional biomarkers (Mahan & Raymond, 2017). Functional medicine practitioners address an interconnectedness of internal physiologic factors within the body. They often use nutrition therapy, dietary supplements, and physical manipulations as the foundation of medical care. In addition, they look for core imbalances, like dietary intake, hormones and neurotransmitters, oxidative stress, detoxification, immune function, and psychological/spiritual health (Mahan & Raymond, 2017).

Use of Functional Medicine

According to the National Center for Complementary and Integrative Health (NCCIH), about 40% of adults in the United States use health care approaches that are outside of the mainstream (Mahan & Raymond, 2017). In poorer countries, modern medicine is very limited. Thus, herbalists and traditional healers are the main sources of health care and guidance among this population. In more prosperous countries, natural therapies are mostly used in accordance with personal beliefs and preferences. It is also most commonly used with western medicine. In U.S. adults, the most popular forms of functional medicine include non-vitamin and non-mineral supplement use. This includes herbs, phytochemicals, fiber, and glucosamine. In addition, many

individuals use chiropractic/osteopathic manipulation, yoga, and massage (Mahan & Raymond, 2017).

Researchers have concluded that the use of functional medicine is greatest among women, people aged 30-69, people with a higher education, those residing in the western U.S., and people who were hospitalized in the previous 12 months (Mahan & Raymond, 2017). In addition, Native Americans, Hawaiians, and Pacific Islanders report the highest use followed by non-Hispanic whites (Mahan & Raymond, 2017).

Functional Interventions for Diabetes

Today, there is a wide variety of interventions and therapies that are associated with functional medicine. The most common interventions that are used among patients suffering from chronic disease, like diabetes, include nutrition, dietary supplementation, yoga, meditation, acupuncture, and massage (Mahan & Raymond, 2017). These interventions work deep within the body to help cure the underlying issues associated with diabetes.

Nutrition. Medical nutrition therapy (MNT) is a main component in the management of Type 2 DM. Common types of MNT include the estimation of energy and nutrients requirements, carbohydrate counting, recommendations for dietary fats and cholesterol and protein intakes, and an explanation of the food exchange list. As the concept of functional foods is expanding, researchers are focusing more on bioactive compounds of functional foods in various aspects of diabetes. The protective effects of these compounds and food sources have been investigated and several clinical trials have even confirmed these advantages in diabetic patients. Commonly discussed functional foods for diabetics include whole grains, phytochemical-rich fruits and vegetables, legumes, and nuts (Mirmiran, 2014).

Dietary carbohydrate sources play an important role in glycemic and insulin secretory response, thus functional grains may be the first step in adopting a functional foods-based diet. Types of functional grains include whole wheat, rye, oats, and barley. Compared to refined grains, whole grains have more non-digestible complex polysaccharides including soluble and insoluble fiber, insulin, beta-glucan, and resistant starches (Mirmiran, 2014). In addition, they also have non-carbohydrate functional components like carotenoids, phytates and phytoestrogens, phenolic acids, and tocopherols. These bioactive compounds have protective effects against obesity, Type 2 DM, cardiovascular diseases, hypertension, metabolic syndrome, and multiple cancers (Mirmiran, 2014). They can effectively regulate glycemic response, increase insulin sensitivity, and improve pancreatic beta cell function and insulin secretion. In addition to hypolipidemic and hypoglycemic effects, the main soluble and fermentable fibers in whole grains act as prebiotics in the gut and modulate gut microbiota be stimulating the growth and activity of bifidobacteria and lactic acid bacteria (Mirmiran, 2014).

Another important strategy for the management of Type 2 DM is the regular consumption of various fruits and vegetables. Fruits and vegetables provide many different micronutrients and bioactive compounds. Several studies reveal that eating phytochemical-rich fruits and vegetables can lead to an improved glycemic control, reduced HbA1c and triglyceride levels, and a decreased risk of diabetic retinopathy (Mirmiran, 2014). Typical functional fruits and vegetables include tomatoes, berries, cherries, pomegranates, garlic, carrots, and dates (Mirmiran, 2014).

Legumes are powerful sources of dietary protein and non-digestible carbohydrates. There is a significant amount of evidence that shows that a regular consumption of legumes has protective effects against Type 2 DM based on bioactive compounds that reduce digestion and

absorption of dietary carbohydrates and modulate postprandial glycemic response. The low glycemic index and high fiber and phytochemical content of legumes have made them functional food for diabetic patients. Studies also show that beans have a hypoglycemic effect as well (Mirmiran, 2014). They have a high content of fibers and fatty acids and their effect on the body is similar to those of anti-diabetic drugs. Beans may help with weight management, regulate glycemic response, and improve dyslipidemia (Mirmiran, 2014).

Lastly, a diet enriched with nuts may be an effective strategy to improve glycemic control and prevent cardiovascular disease in Type 2 DM patients. Nuts are considered rich sources of high-biological value proteins, bioactive peptides, functional fatty acids, fiber, phytosterols, polyphenols, tocopherols, and other antioxidant vitamins (Mirmiran, 2014). Researchers note that consumption of nuts effectively decreases serum levels of high sensitivity C-reactive protein and inflammation markers in the body (Mirmiran, 2014). In addition, a regular intake of nuts may help to manage weight due to thermogenic effects, induction of satiety, decreased dietary fat absorption, and increased fat excretion (Mirmiran, 2014).

Dietary/Herbal Supplementation. Researchers have concluded that more than half of Americans are taking some type of dietary supplement. According to the Food and Drug Administration (FDA), a dietary supplement is a substance that is taken orally and is intended to add nutritional value to the diet. Along with supplements, herbal medicine is used as a primary source of medicine around the world. Herbs and plants provide numerous phytochemicals and bioactive compounds, which are plant-based chemicals and compounds that have biological activity within the human body. In addition, researchers have found that oxidative stress is associated with many chronic illnesses and diseases. Thus, Americans are starting to incorporate antioxidant supplements into their diets (Mahan & Raymond, 2017).

Common herbs that are shown to be beneficial for diabetics include ginseng, aloe vera, cinnamon, garlic, turmeric, and ginger. The roots of ginseng have antioxidant, anti-inflammatory, hypolipidemic, and hypoglycemic properties. The anti-hyperglycemic mechanism of ginseng regulates various insulin signaling pathways to regulate carbohydrate synthesis and revert impaired glucose tolerance or insulin resistance (Venkatakrishnan, Chiu, & Wang, 2019). Researchers revealed that Type 2 DM patients who were given Korean red ginseng for 12 weeks had a significant reduction in the levels of FBG, OGTT, as well as decreased concentrations of serum insulin and C-peptide (Venkatakrishnan, Chiu, & Wang, 2019). Next, aloe vera is a well-known plant for its healing and rejuvenating properties. It is also rich in fiber and starch which helps to promote gut microbiota, thus regulating numerous insulin-related signaling pathways. Researchers noted that oral consumption of 500mg of capsulated aloe vera showed an immense decrease in FBG, HbA1c, TC, TG, and LDL in pre-diabetic patients (Venkatakrishnan, Chiu, & Wang, 2019). Cinnamon has major antioxidant, anti-inflammatory, antihyperglycemic, and antihyperlipidemic properties. Cinnamon can effectively regulate glucose homeostasis by increasing the insulin secretion of GLP-1 and the translocation of GLUT4, thus increasing glucose uptake via the AMPK signaling pathway and reducing intestinal glucose absorption (Venkatakrishnan, Chiu, & Wang, 2019). In Type 2 DM patients, the administration of cinnamon extract for four months showed a moderate reduction in glucose levels without affecting HbA1c levels (Venkatakrishnan, Chiu, & Wang, 2019).

Next, garlic is another common herb with many therapeutic properties, like antioxidant, anti-inflammatory, antihyperglycemic, and anticoagulant benefits. Many studies indicate that garlic acts to increase glucose utilization by upregulating the enzymes involved in glycolysis and glycogenesis (Venkatakrishnan, Chiu, & Wang, 2019). In a randomized, double-blind clinical

trial, researchers reported that treatment with garlic powder tablets for 4 weeks significantly lowered the FBG and TRG levels in those suffering from Type 2 DM (Venkatakrishnan, Chiu, & Wang, 2019). In addition, ginger and turmeric also have anti-diabetic properties. Ginger can directly or indirectly regulate numerous insulin signaling pathways related to insulin sensitivity, protect beta cells, and act as an antioxidant, anti-inflammatory, anti-thrombotic, and hypolipidemic (Venkatakrishnan, Chiu, & Wang, 2019). Turmeric, on the other hand, enhances insulin secretion and transportation. Turmeric is reported to inhibit beta cell apoptosis, emphasize glycolysis and beta oxidation, and inhibit insulin resistance and glucose reabsorption. In a meta-analysis combining seven RCTs with Type 2 DM and hyperlipidemia subjects, ginger reported decreased hyperglycemia and lowered other diabetic related complications (Venkatakrishnan, Chiu, & Wang, 2019). As for turmeric, results showed a significant reduction in FBG, HbAc, TRG, and free fatty acids in Type 2 DM patients when supplemented with turmeric for 3 months (Venkatakrishnan, Chiu, & Wang, 2019).

Although dietary supplements are more commonly used by people who do not have a nutrient deficiency, the Academy of Nutrition and Dietetics has identified various populations that could potentially benefit from supplementation. Populations that may be at risk for nutrient deficiencies include those living in poverty, women taking oral contraceptives, adolescent and pregnant women, the elderly, vegans, those with malabsorption issues, smokers, and alcoholics. Healthcare professionals should be aware of these population groups and should determine if supplementation is necessary to improve nutritional status if dietary changes cannot be made (Mahan & Raymond, 2017).

Yoga. One the major risk factors for cardiovascular disease in diabetes is dyslipidemia, which is due to an increased flux of free fatty acids. Reports from the National Health and

Nutrition Examination Survey (NHANES) indicate that 51% of adults aged 20-59 years old with diabetes have hypercholesterolemia. Researchers have studied and evaluated the effect of exercise on blood lipid profiles and it is noted that physical activity raises HDL levels while decreasing LDL and triglyceride levels. Although exercise is proven to improve dyslipidemia, most diabetic patients cannot sustain the levels of recommended physical activity due to reasons like age, obesity, and other complications (Shantakumari, Sequeira & Deeb, 2013).

Yoga, on the other hand, is a type of exercise that helps to redistribute body fat and reduce central obesity which often leads to insulin resistance. Other proven benefits of incorporating yoga include a decrease in waist hip ratio, an increase in lean body mass, and a reduction in skin fold thickness. By decreasing insulin resistance, there is an increase in insulin receptors and sensitivity. The dynamic stretching of the body during yoga is suggested to rejuvenate pancreatic cells, increase insulin secretion, and correct the impaired insulin-secretion in chronic diabetes. The improvement in lipid profile with the practice of yoga could be due to increased hepatic lipase and lipoprotein lipase, which in turn increases the uptake of triglycerides by adipose tissues and affecting lipoprotein metabolism (Shantakumari et al., 2013).

Meditation. Meditation has been practiced since ancient times and has become an integral part of Eastern religions like Buddhism and Hinduism. Meditation has many different interpretations depending on the culture and includes a wide range of techniques that involve the self-regulation of the mind. This practice helps individuals to develop positive mental attributes, such as, calmness, serenity, joy, and love. Thus, it can reduce stress and improve coping skills, attention, awareness, memory, and cognitive regulation of emotions (Priya & Kalra, 2018).

In a 2007 study, researchers investigated the effect of mediation on those diagnosed with Type 2 DM. They found significant differences in both postprandial plasma glucose (PPG) and

mean blood pressure levels. After only two weeks of practiced meditation after breakfast each morning, there was a significant decrease in the PPG and both systolic and diastolic blood pressure values. In addition, other studies have shown that reducing PPG contributes to a reduction in the level of HbA1c as well. Researchers noted that stress management may play a big role in the prevention and management of diabetes. Stress can affect blood glucose levels and stress hormones, like adrenaline and cortisol, which help mobilize stored energy into glucose and fatty acids in the bloodstream. Stress may also directly affect the nerves controlling the pancreas, which inhibit insulin release. In healthy individuals, these energy sources are quickly utilized by the body. In those with diabetes, the lack of insulin or the presence of insulin resistance causes the newly released glucose to build up in the bloodstream. They concluded that meditation can suppress stress hormones, reduce sympathetic activity, and enhance parasympathetic activity, resulting in decreased blood pressure and plasma glucose levels (Chaiopanont, 2008).

Acupuncture. Acupuncture is a type of traditional practice that dates back about 2,500 years. According to Chinese medicine, energy flows through the body in channels called "meridians", which may be accessed at several hundred points. These points are called "acupoints" and refer to the acupressure points that lie along the channels in your body (Tong, Guo & Han, 2010).

Recent studies have been conducted to determine the beneficial effects of acupuncture in the treatment of diabetic peripheral neuropathy (DPN). DPN is one of the most common complications of diabetes mellitus.   It is a progressive disease characterized by a loss of nerve fibers, which often lead to painful or insensitive extremities and neuropathic ulceration and amputation (Chen, Yang, Liu, Manheimer & Lui, 2013). Studies have shown that 66% of people

with Type 1 DM and 59% of people with Type 2 DM have objective evidence of peripheral neuropathy (Chen et al., 2013). In 2010, researchers concluded that acupuncture treatment significantly improved the symptomatology, specifically the numbness and pain, of DPN patients. This data suggests that acupuncture may accelerate the nerve regeneration process by improving the nerve conduction velocity decreased by DPN (Tong et al., 2010).

Massage Therapy. Massage therapy has been recommended for diabetics for nearly 100 years. Massage has been shown to decrease anxiety in those suffering from chronic disease. Researchers are starting to look at the stress-reducing benefits of massage therapy on normalizing blood glucose levels. By increasing a relaxation response, the counter-regulatory hormones are controlled, allowing the body to use insulin more effectively. Massage therapy can also stimulate better blood movement around the body, improving circulation in those suffering from diabetic neuropathy (Tripathi et al., 2011).

Nutrigenomics. Nutrigenomics is a relatively new concept that refers to the ability of nutrients to alter gene expression (Nino-Fong, Collins, & Chan, 2007). In Type 2 DM, impaired secretion of the hormone insulin is observed, which controls both glucose and fat metabolism. Researchers have suggested that diets high in sugar and saturated fats elicit a condition called "glucolipotoxicity" that negatively impacts beta cells to secrete insulin, resulting in hyperglycemia and/or hyperlipidemia. Evidence shows that hyperglycemia, or elevated glucose, causes a change in gene expression that is directly involved with glucose entry into beta cells and overall glucose metabolism (Nino-Fong, Collins, & Chan, 2007). This data shows significant evidence of the impact of nutrigenomics on disease and sets the baseline for the potential to look further into the relationship between nutrients, gene expression, and the prevalence of chronic disease.

Advantages of Functional Medicine

There are many benefits to adopting the practices of functional medicine. First, the number of uninsured people and lack of healthcare coverage is growing worldwide. Many Americans suffering from chronic disease are struggling to pay for medications, surgeries, and other additional procedures. Doctors and healthcare professionals have revealed that the American people are "overfed, but undernourished." This statement is regarding the fact that our current healthcare system will pay for expensive medical treatments and procedures but refuses to cover the cost of preventative practices, like dietary supplements, acupuncture, and chiropractic care ("Supplement Briefing Discusses Benefits of Functional Medicine", 2010). Although more costly practices of functional medicine are typically not yet covered by most health insurance companies, some aspects of functional medicine may be more cost effective. For example, yoga and meditation may come at little to no cost because many people can take advantage of the internet for a free guided practice. On the other hand, other forms like chiropractic care or acupuncture may be more costly for an individual to utilize.

Another benefit to functional medicine is that it is patient oriented, not disease oriented. Functional medicine prioritizes preventative care and uses a whole-body approach to wellness. Traditional medicine often waits for a disease to be present or measured before intervention and assistance is offered. In addition, functional medicine focuses on biochemical individuality. Functional medicine doctors invest more time into finding out the source of the problem, seeking to address the root cause of the illness. In contrast, traditional medicine doctors seem to treat each medical diagnosis identically, prescribing the same medications and therapy to all patients suffering from the same illness. Traditional medicine seeks to identify symptoms ("Supplement Briefing Discusses Benefits of Functional Medicine", 2010).

Disadvantages of Functional Medicine

Although there are many perks to adopting functional practices, there is also some room for concern from the general public and conventional health care providers. The concepts that raise the most questions relate to the quality, effectiveness, and safety of functional medicine. As the number of people utilizing functional medicine increases, so does the chance that they are using it in combination with conventional care, like prescription drugs and medications. These practices may be used together when approved by a knowledgeable, reputable clinician.

Unfortunately, locating a clinician that has experience and expertise in both types of medicine is uncommon and can be costly. A clinician needs to know enough about the type of practice or supplement, cost, and quality to be able to recommend it to a patient. In addition, he or she must be able to assess the benefits and risks of the practice or supplement, while also being open with the patient about management options (Curtis & Gaylord, 2005). If a patient is unaware of any associated risks to implementing a functional practice in addition to conventional care, there could be significant harm caused. One main concern is that some herbal supplements cannot be used with certain medications due to adverse side effects and drug interactions. For example, the herbal supplement, St. John's Wort, is commonly used to relieve symptoms of depression. Although this herb may have a positive impact on mood and emotional health, it has many dangerous drug interactions with common medications, like warfarin, oral contraceptives and antidepressants.

Next, there is a sufficient lack of evidence surrounding many functional practices, thus the dangers or possible benefits of these treatments remain uncertain (Tabish, 2008). In addition, the diagnostic procedures and product testing processes are different from those utilized by conventional clinicians, therefore there is a high concern about the accuracy and safety of these

methodologies (Curtis & Gaylord, 2005). Common diagnostic procedures include toxic metal analysis, food/chemical/environmental sensitivity tests, and neurotransmitter tests. Although these methods are unfamiliar to conventional clinicians, it does not mean they are unsafe or invalid (Curtis & Gaylord, 2005). Research suggests that some of these diagnostic techniques are valid and reliable, while others are not. For most of these procedures, there is no research suggesting that they are harmful nor effective (Curtis & Gaylord, 2005).

The regulatory processes of functional products are vastly different from prescription drugs and medications. For example, herbs and supplements are regulated as food rather than medicine, thus they lack the safety assurance policies that are required of pharmaceuticals (Curtis & Gaylord, 2005). The United States has a limited regulation of alternative products and treatments, which have led to increasing issues with labeling and mislabeling, misrepresentation, misapplication and adverse effect reporting (Curtis & Gaylord, 2005). Mislabeling occurs when the product does not contain the items listed on the label or has ingredients with incorrect concentrations (Curtis & Gaylord, 2005). Many labels also fail to indicate the toxic agents, like heavy metals, in herbal products. As for misrepresentation and misapplication, many companies promote therapies or products which are unproven, disproven, or have yet to be thoroughly examined (Curtis & Gaylord, 2005). Misapplication, on the other hand, may occur due to a lack of understanding by the consumer or a lack of training by the practitioner (Curtis & Gaylord, 2005). In addition, adverse side effects may be difficult to identify due to the lack of reliable information on most herbal products and supplements. Researchers suggest that those who regularly use functional products often fail to report abnormal symptoms as adverse effects, thus many of these side effects may go unnoticed (Curtis & Gaylord, 2005).

Functional Nutrition

Although the concept of functional foods and nutrition may seem like a new health trend, it has been around for quite some time. Approximately two thousand years ago, Hippocrates embraced the belief in the therapeutic properties of food with his statement, "Let food be thy medicine and medicine be thy food". Today, the saying might go "Let functional food be thy medicine" (Martirosyan & Singh, 2015). Functional nutrition first emerged in the United States in the 1800s when scientists started to identify different nutrients needed for human growth and survival. As the field of nutrition advanced, dietary guidelines, recommended daily allowances (RDAs), and reference nutrition intakes (RNIs) were constructed in the 1970's to define how much of a nutrient is needed to support human health (Martirosyan & Singh, 2015). Today, functional nutrition is a collaboration of both food science and pharmaceuticals. It is the practice of considering all aspects of an individual's diet, lifestyle, and health status when prescribing nutrition recommendations (Martirosyan & Singh, 2015).

Functional foods are those that contain biologically active ingredients associated with physiological health benefits for preventing and managing chronic disease (Alkhatib et al., 2017). These foods or supplements are categorized as "functional" based on their ability to improve overall health and well-being, decrease the risk of chronic diseases, or minimize the effects of other health concerns (Kapsak, Rahavi, Childs & White, 2011). This is determined by researchers who study food components and their beneficial health effects and specifically measure changes in health and homeostatic behavior through different biomarkers in the body (Martirosyan & Singh, 2015). With this knowledge, they can establish the health effects and safe dosages of these functional foods. Research has shown a significant relationship between functional components in foods and health and well-being, thus functional components of food can be effectively applied in the treatment and prevention of disease (Abuajah, 2019).

Consumer Acceptance of Functional Nutrition

Numerous surveys conducted over the past few decades have revealed that American consumers are taking more responsibility for their health and well-being by focusing on cleaning up their current diet (Kapsak et al., 2011). In a consumer trend report from the Food Marketing Institute, 76% of consumers said that they strongly or mostly agreed that eating healthfully is a better way to manage illness than medication (Hasler, 2002). In 2009, the IFIC Functional Foods for Health Consumer Trending Survey showed that 43% of Americans were "very interested" in learning more about functional foods and 41% were "somewhat interested". Researchers concluded that individuals, now more than ever, are viewing their kitchen cabinet as their medicine cabinet (Kapsak et al., 2011).

Consumer interest in functional nutrition remains strong for a variety of reasons. One major motive for consumers is the increasing cost of healthcare in the United States. It has been projected that 1 in 3 individuals will develop Type 2 DM by 2050 (Powers & Marrero, 2015). The U.S. healthcare system will be unable to afford the costs of care unless incidence rates and diabetes-related complications are reduced (Powers & Marrero, 2015). In addition to rising healthcare costs, consumers are interested in the relationship between functional foods and chronic disease. According to the 2009 IFIC Functional Foods for Health Consumer Trending Survey, 89% of consumers agree that certain foods have benefits that go beyond basic nutrition and may reduce the risk of disease (Kapsak et al., 2011). This survey also revealed that 92% of Americans were able to name a specific food or food component and its associated health benefit (Kapsak, Rahavi, Childs & White, 2011). This data represents a significant increase compared with 84% in 2002, 82% in 2000, and 77% in 1998 (Kapsak et al., 2011).

In 2004, researchers determined that people must understand the "what" and why"

components in order to consume functional foods (Wansink, Westgren, & Cheney, 2005). They

must know what benefits will arise from consuming functional foods and why the food provides

the associated benefits. Although an individual may be able to acknowledge the health benefits

of consuming certain foods, it is shown that they will be less likely to consume it unless they can

link the health benefits with the reasons these foods provide them (Wansink, Westgren, &

Cheney, 2005). For example, many people know about the attributes of soybeans, but they do

not necessarily know why they should consume it or how it functions within the body. On the

other hand, people may be more likely to consume soybeans if they knew why soybeans provide

nutritional and functional properties. More evidence suggests that age might also influence the

consumption of functional foods (Ozen, Pons & Tur, 2012). Adults and older adults may have a

stronger interest than younger individuals in improving their health with functional foods. This

can be attributed to their desire to manage and prevent chronic diseases that they may have or

may be prone to in the future (Ozen, Pons & Tur, 2012).

In a 2010 study, a researcher determined that 38% of adults in the United States were

using some form of CAM, which was a 2% increase from previous 2002 data (Ventola, 2010).

CAM usage was observed most frequently among women and adults with higher incomes and

advanced levels of education (Ventola, 2010). Of those utilizing CAM therapies, dietary

supplements were found to be the most frequently used form (Ventola, 2010). In addition, this

study also addressed the variety of reasons for an increased use of CAM among this population.

First and foremost, patients could be dissatisfied with conventional medicine for a multitude of

reasons. Patients may expect conventional medicine to solve all of their health-related problems

and may often turn to alternative medicine if or when traditional care fails (Ventola, 2010). This

can be attributed to any adverse side effects, cost, lack of efficacy, or a poor doctor-patient relationship. Next the idea of self-healing that CAM therapies provide may be attractive in those trying to manage a chronic disease. Patients may prefer this type of autonomy and feel more personally empowered and in control of their own health. Lastly, cultural influences may also be apparent as our American society is multicultural and includes many first-generation immigrants who most likely have previous experience with CAM practices (Ventola, 2010).

Although dietary supplements are the most used form of CAM, researchers concluded that health care professionals rarely ask about, document, or monitor their patients' use of any dietary supplements (Ventola, 2010). Studies have indicated that most dietary supplements are purchased in pharmacies, thus pharmacists and physicians are in a good position to provide education regarding the safety, efficacy, and potential drug-supplement interactions at point of sale (Ventola, 2010). Prior research suggests that pharmacists and physicians feel as though they currently lack the knowledge, confidence, and training to provide guidance to those who are interested in adopting CAM therapies. As evidence continues to prove that more and more Americans are utilizing CAM, health care professionals must be trained and educated on the various CAM treatments and practices their patients may be using in order to better direct them and counsel them to make healthful decisions.

Healthy Eating Guidelines

Recommended healthy eating patterns for U.S. adults are similar from early adulthood (19-30 years of age) through middle adulthood (31-50 years of age) into late adulthood (51+ years of age) (What is my plate?, n.d.). The U.S. Department of Agriculture (USDA) makes all dietary recommendations based on age, sex, and physical activity. Estimates range from 1,600-2,400 calories per day for adult women and 2,000-3,000 calories per day for adult men. Within

each age and sex category, the low end of the range is for sedentary individuals and the high end is for active individuals (What is my plate?, n.d.).

Micronutrient Needs of Adults

Overall adherence to the U.S. Dietary Guidelines is low, thus the majority of Americans do not follow a healthy eating pattern (Drake & Frei, 2019). When paired with physical inactivity, eating an energy-rich, nutrient poor diet predisposes an individual to a variety of chronic diseases, including type 2 diabetes (Drake & Frei, 2019). According to the National Institutes of Health (NIH), adults (19+ years of age) have specific Recommended Dietary Allowances (RDA) and Adequate Intakes (AI) for each micronutrient. The RDA for vitamin A is 900 mcg/d for men and 700 mcg/d for women (Institute of Medicine [IOM], 2011). For vitamin C, it is 90mg/d for men and 75 mg/d for women. For vitamin D, it is 15 mcg/d and 15mg/d for vitamin E for both men and women. The RDA for thiamin is 1.2 mg/d for men and 1.1 mg/d for women, riboflavin is 1.3mg/d for men and 1.1 md/d for women, and niacin is 16mg/d for men and 14mg/d for women. For vitamin B6, the RDA is 1.3mg/d for men aged 19-50 and 1.7mg/d for men aged 51+. For females, the RDA for vitamin B6 is 1.3mg/d for those aged 19-50 and 1.5mg/d for those aged 51+. Lastly, the RDA for folate is 400mcg/d for both men and women and vitamin B12 is 2.4mcg/d for both sexes as well. As for AI, vitamin K is valued at 120 mcg/d for men and 90 mcg/d for women. The AI for pantothenic acid is 5mg/d and biotin is 30mcg/d for both men and women (IOM, 2011).

Macronutrient and Energy Needs of Adults

Macronutrients are compounds that are needed in high quantities to help the human body function on a daily basis. The three macronutrients in nutrition are carbohydrates, lipids, and proteins. The Dietary Guidelines for Americans suggests that each macronutrient be met

according to their Dietary Reference Intake (DRI). The DRI for carbohydrates is 45-65% of total daily energy. For protein, 10-35% is made up of total energy and 20-35% for fat (IOM, 2011). Approximately 10% of the total energy can come from omega-6 fatty acids or omega-3 fatty acids. Additional macronutrient recommendations include limiting added sugars to no more than 25% of total energy and keeping dietary cholesterol, trans fatty acids, and saturated fatty acids as low as possible while consuming a nutritionally adequate diet (IOM, 2011).

MyPlate Guidelines

The MyPlate guidelines were developed by the United States Department of Agriculture (USDA) and are used to promote a healthy eating style based on the 2010 Dietary Guidelines for Americans (What is my plate?, n.d.). It's an icon that serves as a reminder for healthy eating and emphasizes five food groups: fruits, vegetables, grains, protein, and dairy products (What is my plate?, n.d.). This food guide was created to replace the MyPyramid food guidance system developed in 2005. A healthy eating pattern includes a variety of colorful vegetables, at least 2.5-3 cups per day for men and 2-2.5 cups for women, from all of the subgroups-- dark green, red and orange, legumes (beans and peas), and starchy vegetables (What is my plate?, n.d.).Vegetable choices should vary from day to day and be consumed in a nutrient-dense form, without additions such as salt, butter, or creamy sauces ("Dietary Guidelines for Americans 2015-2020", 2015). Individuals should also focus on incorporating whole fruits and whole grains into their diets, along with fat-free or low-fat dairy products, including milk, yogurt, cheese, and fortified soy beverages (What is my plate?, n.d.). Whole fruits include fresh, canned, frozen, and dried forms and the recommended intake is 2 cups per day for men and 1.5-2 cups for women (What is my plate?, n.d.). Healthy eating patterns include 6-8 ounces of grains per day for men and 5-6 ounces for women, half of which are whole grains, and a limited intake of

refined grains, especially those high in saturated fats, sodium, and added sugars (What is my plate?, n.d.). The recommended amounts of dairy are based more on age rather than caloric intake and adults should aim to consume 3 cups per day (What is my plate?, n.d.). At least 5.5-6.5 ounces of protein per day for men and 5-5.5 ounces for women from various plant and animal sources, like seafood, lean meats and poultry, eggs, legumes, nuts, and seeds should also be incorporated into the diet on a daily basis (What is my plate?, n.d.). A healthy eating pattern limits the amount of saturated and trans fats consumed and incorporates oils in place of butter or margarine. Although oils are not a food group, the recommendation is about 6-7 teaspoons for men per day and 5-6 teaspoons for women due to the fact that they are a major source of essential fatty acids and vitamin E (What is my plate?, n.d.). Adults should consume less than 10% of calories per day from added sugars and saturated fats (What is my plate?, n.d.). They should also aim to eat less than 2,300 milligrams of sodium per day (What is my plate?, n.d.). In addition, if alcohol is consumed, it should be consumed only in moderation by adults of legal drinking age. One alcoholic drink is equivalent to 12 fluid ounces of beer, 5 fluid ounces of wine, or 1.5 fluid ounces of 80 proof distilled spirits. The alcohol recommendation is one drink per day for women and two drinks per day for men ("Dietary Guidelines for Americans 2015-2020", 2015).

Table 1
U.S. Department of Agriculture MyPlate Dietary Guidelines for Men

MyPlate Category	19-30 years old	31-50 years old	51+ years old
Fruits	2 cups	2 cups	2 cups
Vegetables	3 cups	3 cups	2.5 cups
Protein	6.5 ounces	6 ounces	5.5 ounces
Grains	8 ounces	7 ounces	6 ounces
Whole Grains	4 ounces	3.5 ounces	3 ounces
Dairy	3 cups	3 cups	3 cups
Oils	7 teaspoons	6 teaspoons	6 teaspoons

Note: Data retrieved from https://www.choosemyplate.gov/eathealthy/WhatIsMyPlate.

Table 2

U.S. Department of Agriculture MyPlate Dietary Guidelines for Women

MyPlate Category	19-30 years old	31-50 years old	51+ years old
Fruits	2 cups	1.5 cups	1.5 cups
Vegetables	2.5 cups	2.5 cups	2 cups
Protein	5.5 ounces	5 ounces	5 ounces
Grains	6 ounces	6 ounces	5 ounces
Whole Grains	3 ounces	3 ounces	3 ounces
Dairy	3 cups	3 cups	3 cups
Oils	6 teaspoons	5 teaspoons	5 teaspoons

Note: Data retrieved from https://www.choosemyplate.gov/eathealthy/WhatIsMyPlate.

Current Eating Patterns of US Adults

The current eating patterns consumed by adults in the United States do not align with the recommended dietary guidelines. When comparing the current intake with the recommended intake, three-fourths of the population does not meet the recommended requirements for vegetables, fruits, dairy, or oils ("Dietary Guidelines for Americans 2015-2020", 2015). In contrast, more than half of the population is meeting or exceeding total grain and protein recommendations. More specifically, adult men and women are consuming less than 2 cups of vegetables each day. Men are eating between 1-1.5 cups of fruit each day and women are eating less than 1.5 cups per day on average. About one-third of fruit intake comes from fruit juice, while the other two-thirds is from whole fruits. As for total grains, all men and most women are consuming adequate amounts per day, with the exception of women aged 31-50 years ("Dietary Guidelines for Americans 2015-2020", 2015). As for grains, most consumed do not meet the recommendations for whole grains and exceed the limits for refined grains ("Dietary Guidelines for Americans 2015-2020", 2015). Both men and women are significantly below the recommended dairy intake, residing at 1.5-2 cups per day for men and 1-1.5 cups for women. All men and women are meeting or are above the recommendations for protein. Overall, average

intakes of seafood are low for all men and women, nuts and seeds are close to recommended levels, and the average intake of meat, eggs, and poultry are high for men. The current oil intakes for both men and women are slightly under the recommended amount and the amount of solid fat exceeds the recommended limit ("Dietary Guidelines for Americans 2015-2020", 2015).

In addition to these findings, the Behavioral Risk Factor Surveillance System (BRFSS) collected data regarding health-related risk behaviors and chronic health conditions. The Center for Disease Control and Prevention (CDC) used this data to construct a report to estimate the percentage of each state's population meeting intake recommendations by age, sex, race/ethnicity, and income-to-poverty ratio (IPR) for each of the 50 states and District of Columbia (DC) ("Disparities in State-Specific Adult Fruit and Vegetable Consumption", 2018). Researchers asked six questions on how many times per day, week, or month American adults consumed 100% fruit juice, whole fruit, dried beans, dark green vegetables, orange vegetables, and other vegetables. In 2015, Americans consumed fruit only one time per day and 1.7 times per day for vegetables ("Disparities in State-Specific Adult Fruit and Vegetable Consumption", 2018). Among all participants, 12.2% met their fruit intake recommendations and 9.3% met their vegetable intake recommendations ("Disparities in State-Specific Adult Fruit and Vegetable Consumption", 2018).

Researchers also found that a higher percentage of women, rather than men, met their daily fruit and vegetable needs ("Disparities in State-Specific Adult Fruit and Vegetable Consumption", 2018). In addition, young adults aged 18-30 showed the lowest percentage for meeting these goals, while individuals aged 51+ revealed a higher percentage ("Disparities in State-Specific Adult Fruit and Vegetable Consumption", 2018). In 41 states, young adults consumed less vegetables than older adults, however, they only consumed less fruit than older

adults in 18 states ("Disparities in State-Specific Adult Fruit and Vegetable Consumption", 2018). In 10 states, a higher proportion of African Americans and Hispanics met the fruit intake recommendations over whites ("Disparities in State-Specific Adult Fruit and Vegetable Consumption", 2018). Overall, a lower percentage of African Americans met recommendations for vegetable intake versus whites and Hispanics ("Disparities in State-Specific Adult Fruit and Vegetable Consumption", 2018). As for the role of socioeconomic status, a higher percentage of individuals living in the highest category for household incomes met the recommendation for vegetables in 35 states and for fruits in just four states ("Disparities in State-Specific Adult Fruit and Vegetable Consumption", 2018). This report reveals that the overall fruit and vegetable consumption is low in the United States, possibly contributing to the rising prevalence of cardiovascular disease, type 2 diabetes mellitus, and cancer.

Factors Affecting Nutrient Intake

There are many factors, such as economical, physical and social, that contribute to overall nutrient intake. Strong predictors of diet intake consist of education level, social meal patterns, socioeconomic status, and race and ethnicity.

Education

There are numerous identified factors that play a significant role in the overall dietary intake of adults. Researchers have found that education is one of the most important predictors of nutrient-based diet quality (Raffensperger et al., 2010). Adults with a college diploma had higher intakes of whole fruits, total vegetables, and whole grains compared to all other education levels (Hazel, Davis, Casavale & Guenther, 2013). On the other hand, those with less than a high school diploma had an increased intake of saturated fat and sodium compared with all other education levels (Hazel et al., 2013). This pattern was similar for older adults and may reveal the

importance of nutrition knowledge and overall higher education. These results can be

contributed to the fact that those with a college diploma were more likely to understand why and

how to incorporate nutrition knowledge into their dietary practices (Hazel et. al., 2013).

In a study involving health literacy and nutrient quality, researchers assessed the

relationship between education and the associated quality of diet, specifically focusing on

micronutrient intakes (Kuczmarski, 2016). Health literacy is defined as "the degree to which

individuals have the capacity to obtain, process, and understand basic health information and

services needed to make appropriate health decisions" (Kuczmarski, 2016). Health literacy plays

a key role in whether or not an individual can process and understand basic health information in

order to make healthful decisions. The benefits of health literacy improvement include improved

communication, greater adherence to treatment, greater ability to engage in self-care, improved

health status, and greater efficiency and cost savings to the health system as a whole (Advocate

for Health Literacy in Your Organization, n.d.). Their findings provide evidence that health

literacy was a significant predictor of diet quality based on total micronutrient intake. Those

with higher education levels had significantly higher diet quality compared to those with lower

education levels (Kuczmarski, 2016).

Eating Outside the Home

Aside from education, one of the most discussed factors in research today includes the

prevalence of eating away from home. The consumer price index (CPI) estimates that

Americans spend more than 52% of their food dollars away from home (Mahan & Raymond,

2017, p. 359). A 2016 study confirmed findings from previous literature of the positive

association between fast-food consumption and daily total calorie, fat, and sugar intake (An,

2015). In addition, fast food consumption was also linked with an increased intake of cholesterol

and sodium, and a lower intake of fiber, vitamin A, vitamin C, vitamin D, vitamin K, copper and

magnesium (An, 2015).

Another study examined the relationship between the number of meals prepared at home

and the risk for developing diabetes. Researchers analyzed data for 58,051 American women

and 41, 676 American men followed from 1986-2010 who reported the amount of times they

prepared their meals at home per week (Zong, Eisenberg, Hu & Sun, 2016). They also evaluated

the participants' amount of weight gain and risk of obesity (Zong, Eisenberg, Hu & Sun, 2016).

During years of follow-up, 9,356 cases of diabetes were documented. They found that an

increased consumption of eating meals that were prepared at home was significantly associated

with a lower risk of developing diabetes. In addition, a frequent consumption of meals prepared

at home was associated with slower weight gain and a lower risk of developing obesity (Zong et.

al, 2016).

Socioeconomic Status

Another factor that may affect overall dietary intake is socioeconomic status (SES).

Those who are of a lower SES may not have the funds to support a well-balanced, healthy diet.

For example, purchasing various protein foods like meats and nuts, can often be more costly than

purchasing a processed, ready-to-go meal. In a 2012 study, researchers concluded that both low-

income young and middle-aged adults had a lower diet quality, except for sodium, than those

with a higher income (Hazel et al., 2013). They also noted that income had a minimal impact on

diet quality for older adults (Hazel et al., 2013). This could be due to the plethora of resources

that are available to older adults to aid in their nutrient intake, like Meals on Wheels, Senior

Farmers' Market Nutrition Program (SFMNP), and the Commodity Supplemental Food Program

(CSFP). Along with SES, the environment may also play a key role in nutrient intake. Lower

income populations often live in areas known as "food deserts", meaning they have limited access to affordable and nutritious food.

In another study regarding eating patterns and food insecurity, researchers found that the home food environment was poorer in food-insecure households than food-secure households (Bruening, Neumark-Sztainer, Loth, Maclehose, & Story, 2011). They determined that food insecurity was associated with overall poorer nutrition related outcomes, like higher percentages of overweight, obesity and binge eating. Food-insecure adults also reported less access to fruits and vegetables and lower quality of food served at meals (Bruening et al., 2011). When asked questions concerning food choices, adults suffering from food insecurity generally reported having more fast food at family meals and serving sugar-sweetened beverages often (Bruening et al., 2011). In contrast, food-secure individuals reported serving healthier foods, like salad, vegetables and fruits in their homes. In addition, 39.8% of food-insecure individuals reported that fruits were too expensive to purchase compared with only 13.6% of food-secure individuals (Bruening et al., 2011).

The findings of higher weight status and poorer eating patterns among those with a lower SES may be related to an unreliable access to healthy foods, like fruits and vegetables. Research shows that lower income populations often shop at smaller corner/convenient stores in their neighborhood (Bruening et al., 2011). Food items at these stores may be 150-400% more expensive than average grocery stores due to the way these stores operate (Bruening et al., 2011). Convenience stores deal with a low volume of shoppers, thus they have specified fixed costs which are spread over fewer daily transactions, making the overall prices higher. The data regarding the prevalence of binge eating and obesity within the lower income population can be related to the cycle of food deprivation and overeating among these individuals. Restricting

intake when there is a lack of food and overeating when there is an influx of food can promote the storage of fat, creating an unhealthy distribution of fat in the body and a poor relationship with food (Bruening et al., 2011).

Race and Ethnicity

Race and ethnicity may greatly impact the types of foods individuals choose to consume on a daily basis. In 2010, researchers examined the differences in diet between white and African American men and women in the United States (Raffensperger et al., 2010). Their results showed a significant difference in nutrient intake between the two races. They concluded numerous differences between the types of foods each group was consuming (Raffensperger et al., 2010). For example, African Americans are choosing more vitamin-C fortified beverages and less calcium-rich beverages than white Americans. They also reported that African Americans are less likely to make selections from food groups rich in potassium and calcium, like foods from the fruit, vegetable, and dairy groups (Raffensperger et al., 2010). The lower quality diet in African Americans may stem from the cultural differences in the selection and preparation of foods. An example of this is the consumption of "soul foods" within the African American race. "Soul foods" include pork, pork fat, chicken, organ meats, corn, sweet potatoes, and greens (Raffensperger et al., 2010). Traditionally, these foods are cooked in fat back or ham hocks, which can significantly increase the caloric intake of the meal and decrease the amount of nutrients and vitamins obtained from food (Raffensperger et al., 2010). These foods and cooking techniques are rooted in the African American culture, as many individuals still cook in this way today to preserve their tradition. In relation to this, researchers reasoned that African Americans may view making "healthy" food choices as conforming to the dominant culture, which may be

the cause for such a significant difference between each of the dietary intakes (Raffensperger et al., 2010).

In a 2004 study, researchers developed a questionnaire to measure food-related attitudes and gain a better understanding of how health and non-health-related factors influence dietary choices (Kolodinsky et al., 2008). They explored the acceptance of functional foods cross-culturally, focusing on how food attitudes and other cognitive factors may condition an adherence to regular functional food consumption. The participants for this study were Canadian, American, and French young adults, both men and women. Researchers found small, yet significant, differences among the general food attitudes of Candian, American, and French adults. Their results showed that Canadians ranked cooking enjoyment, pleasure, diet-health link, and innovativeness higher than both Americans and French participants (Kolodinsky et al., 2008). Also, Americans ranked convenience, health consciousness, and ethnic food enjoyment above their peers, while the French repeatedly reported the lowest rankings on each scale (Kolodinsky et al., 2008). Overall, participants in all three countries slightly favored convenience and the diet-health link, while slightly disfavoring new foods (Kolodinsky et al., 2008).

Researchers also discovered that there were apparent attitudinal differences between men and women (Kolodinsky et al., 2008). There were significant differences in the level of cooking enjoyment between men and women in Canada and the United States. Rankings showed that all women in each country valued cooking enjoyment more than males, but French women revealed to value cooking enjoyment significantly lower than their American and Canadian peers (Kolodinsky et al., 2008). In addition, all women reported higher rankings in the diet-health link and health consciousness categories than men (Kolodinsky et al., 2008). There were slight

differences between the sexes in the importance of convenience; American men were shown to rank the highest and only Canadian women ranked higher than their male counterparts (Kolodinsky et al., 2008). In regard to functional foods, knowledge was greater among Americans than Canadians, but both women from each country strongly believed in the benefits of consuming functional foods (Kolodinsky et al., 2008). French adults indicated the least amount of knowledge, as well as the least favorable attitudes towards functional foods, although they had a strong belief in the benefits (Kolodinsky et al., 2008). Differences in nomenclature, education, product labeling, and marketing may be the most crucial factors contributing to these findings (Kolodinsky et al., 2008).

CHAPTER III

METHODOLOGY

Overview

This study utilized a non-experimental, posttest only design. The purpose of this study was to investigate the current knowledge and beliefs, along with utilization of the various practices of FM and IFN among adults with or without diabetes mellitus in Northeast Ohio. Both an individual's prior knowledge and beliefs of FM/IFN were assessed using two questionnaires: Knowledge of FM/IFN and CAM Health Belief Questionnaire (CHBQ). The participant's utilization was investigated with seven questions regarding the utilization of vitamins, minerals, and herbal supplements. In addition, the participant was asked about their experiences with nutrigenomics and various CAM methods. The independent variable was identified disease state, with or without diabetes. The dependent variables were the scores on the Knowledge of FM/IFN and CHBQ questionnaires.

Participants

The sample for this study was a convenience sample of approximately 2,700 full and part-time faculty and 3,000 staff members at a large Midwestern University. The participants included both males and females. Participants were included regardless of ethnicity, living situation, or economic status. No compensation or incentive was provided for their participation. If individuals received the study but data was incomplete, they were excluded from data analysis. Individuals who did not identify gender (male, female, or prefer not to answer) were also excluded from the sex-specific results because their data could not be categorized for comparison.

Questionnaire

An online survey, consisting of five sections, was utilized in this study. Section I: Knowledge of FM/IFN, Section II: Complementary and Alternative Medicine Health Belief Questionnaire (CHBQ), Section III: Utilization of FM/IFN, Section IV: Demographics.

Section I: Knowledge of FM/IFN

To measure the participant's current knowledge of functional medicine and integrative and functional nutrition, the investigator developed an 8-item questionnaire from the literature to determine if prior knowledge had an effect on the utilization of function medicine and integrative and functional nutrition (FM/IFN). The questions were created by the researcher and consisted of various topics, like functional foods and mind-body techniques, in relation to the complications of Type 2 DM. The questions were scored with one point given to every correct answer. A higher score indicated an increased knowledge of FM/IFN.

Section II: Complementary and Alternative Medicine Health Belief Questionnaire (CHBQ)

The CHBQ, developed by Lie and Boker, was a 10-item measure of attitudes and beliefs regarding complementary and alternative medicine (CAM). This tool covered CAM issues along with attitudes toward a holistic approach. Traditionally, it was constructed and administered to medical students to determine their awareness and use of primary CAM modalities. Its aim was to understand an individual's attitudes toward CAM and understand the role of a provider's communication with the patient and treatment approach. The items were framed in a seven-point, Likert-type rating scale format (1 = "absolutely disagree" to 7 =" absolutely agree"). The higher the score, the greater endorsement and more positive attitude towards CAM. In the

CHBQ, three items were worded negatively to minimize acquiescence. The maximum possible score was 70 with a hypothetical midpoint of 35.

Section III: Utilization of FM/IFN (UFM/IFN)

In this section, the researcher created six FM/IFN questions to determine the utilization of these practices within the targeted population. These questions covered the topics of high interest, such as, the use of dietary/herbal supplements, nutrigenomics, and complementary and alternative therapies for diabetes. These questions provided details about the participant's current usage of vitamin, mineral, or herbal supplementation, along with their interest in nutrigenomics and utilization of CAM therapies.

Section IV: Demographics

The last part of the questionnaire included a 9-item demographics survey. Participants were asked about their age, sex, ethnic background, education level, religion, and history of disease. In addition, they were also asked to insert their height and weight, which was then used to calculate BMI status.

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Data Collection Procedures

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This study was approved by the Institutional Review Board (IRB) during Summer of 2020. After receiving IRB approval, email addresses were obtained through the University Provost's office. In this email, there was a link to the consent form in which participants electronically agreed or disagreed to partake. The questionnaire was created and distributed through Qualtrics XM, an electronic survey system, by email on September 15th, 2020. This questionnaire remained available to participants until September 24th, 2020. All completed questionnaires remained anonymous.

The questionnaire started with informed consent, requiring participants to agree to participate by clicking on the link to the questionnaire. Participants then began answering eight true or false questions regarding their knowledge of FM/IFN. Next, the participant's attitude towards CAM was measured using Cobb's 20-item survey utilizing a 5-point Likert scale from strongly disagree (1) to strongly agree (5). Each statement on the survey was developed to measure a particular aspect related to participants' attitudes toward CAM. Although this data was collected, it was not analyzed due to a misunderstanding of how to properly score this questionnaire. Following this, participants were directed to the next screen where they answered 10 CAM health belief questions on a seven-point, Likert-type rating scale format (1 = "absolutely disagree" to 7 =" absolutely agree"). Next, they completed the seven-item utilization of FM/IFN questionnaire. These questions were used to determine the participant's current use and acceptance of functional practices and techniques, such as dietary/herbal supplementation, nutrigenomics, and other CAM-related therapies. The final section of the questionnaire asked demographic questions in which participants responded with their age, sex, ethnic background, education level, religion, and history of disease. In addition, they were also asked to insert their height and weight in order to determine BMI status. Participant responses were collected using Qualtrics XM and were then downloaded into a Microsoft excel file to be organized for analysis purposes.

Data Analysis

Data was uploaded and analyzed using SPSS Version 25. Using standard units, data was uploaded into an excel sheet and a formula (BMI= (body weight in pounds/height in inches^2)*703) was used to calculate body mass index (BMI). Demographic data was analyzed using central tendencies, means and standard deviations, and frequencies. A t-test was run on the

knowledge of FM/IFN and CHBQ means to determine if a significant relationship was detected

between participant scores for those with and without diabetes. The value of significance for

these statistics was $p \leq .05$.

CHAPTER IV

JOURNAL ARTICLE

Introduction

Diabetes is a group of diseases characterized by high blood glucose concentrations that occur when the body cannot make or effectively use its own insulin. This disease currently affects ~34 million people and by 2030, it is estimated that 1 in 3 Americans will develop diabetes (CDC, 2020). In addition to the rising prevalence of diabetes, healthcare costs and the number of uninsured people are also growing. The costs of common traditional diabetes interventions, like blood sugar lowering medications, insulin injections, and insulin infusion pumps, can add up quickly. As a result, many people are struggling to receive the treatments or care they need to help manage their disease ("Supplement Briefing Discusses Benefits of Functional Medicine", 2010). Aside from these common interventions, Medical nutrition therapy (MNT) may also be beneficial. MNT can play a vital role in a patient's disease management by guiding the patient to focus more on diet and exercise while incorporating an insulin regimen into his or her daily routine.

Although conventional diabetes treatments and interventions are proven to be effective for some, functional medicine (FM) or integrative and functional nutrition (IFN) may also aid in allowing individuals to create necessary lifestyle changes to control their diabetes. These processes seek to understand the genetic, biochemical, and environmental differences in each person. Functional medicine specialists understand that each individual is biochemically unique, thus they usually perform additional testing or research to uncover any additional factors that could play into a patient's health background ("Functional Medicine and Integrative Medicine", 2019). On the other hand, IFN is more nutrition-focused, although a variety of factors are taken

into consideration when assessing a patient. IFN is focused on identifying the main imbalances related to a disease and geared more towards a personalized nutrition regimen, including therapeutic meal plans, dietary supplements, and mind and body practices.

In addition, two terms defined as "integrative medicine" and "complementary and alternative medicine (CAM)" are also well-known. Integrative medicine indicates an approach that combines conventional medicine with alternative medicine, while CAM refers to the specific practices that may be complementary or alternative to conventional medicine (Complementary Medicine Education and Outcomes Program, n.d.). Researchers have studied the effects of functional interventions on diabetic patients, like dietary supplementation, yoga, meditation, acupuncture, and massage therapy. These interventions have been proven to regulate glycemic response, increase insulin sensitivity, and improve pancreatic beta cell function and insulin secretion (Mahan & Raymond, 2017).

As the incidence and mortality rates of diabetes progress, a change in the treatment approach may be necessary. It is important to investigate the relationship between diabetes and functional foods or interventions, along with the diabetic population's acceptance and success with the use of these practices. Although there is sufficient evidence to support the use of functional foods as a major factor in the prevention of diabetes, there is little evidence to show how often these practices are used and accepted by both healthcare professionals and individuals with diabetes. The gathering of this data will allow for a better understanding of the interest and knowledge of various functional practices. Therefore, the purpose of this study is to investigate the current knowledge and beliefs, along with utilization of the various practices of functional medicine (FM) and integrative and functional nutrition (IFN) among adults with or without diabetes mellitus.

Methodology

The participants for this study were a convenience sample of faculty and staff employees at Kent State University. Participants included those 18 years or older and both male and females. Participants were included regardless of race, ethnicity, or economic status. No compensation or incentive was provided for participation. If individuals received the study but data was incomplete, they were excluded from data analysis.

Materials

An online questionnaire was sent to participants via their university email addresses provided by the university registrar. The questionnaire contained four parts: (1) a researcher developed Knowledge of FM/IFN Questionnaire, (2) the Complementary and Alternative Medicine Health Belief Questionnaire (CHBQ), (3) a researcher developed Utilization of FM/IFN, and (4) a set of demographic questions.

Knowledge of FM/IFN

This section of the questionnaire was aimed at asking questions to better understand how much prior knowledge the participant had on function medicine and integrative and functional nutrition (FM/IFN). A review of the qualitative and quantitative literature influenced the investigator to develop a FM/IFN survey on prior knowledge. In research conducted by Alzahrani et al., similar questions were asked to medical students regarding certain CAM modalities of treatment (Alzahrani et al., 2016). In this study, the researcher was influenced to develop a set of questions using the same format yet geared towards various FM/IFN therapies that are commonly used to manage diabetes. These eight questions consisted of various topics, like functional foods and mind-body techniques, in relation to the complications of diabetes. The

questions were scored with one point given to every correct answer. A higher score indicated an increased knowledge of FM/IFN.

Complementary and Alternative Medicine Health Belief Questionnaire (CHBQ)

This section was a 10-item measure of attitudes and beliefs regarding complementary and alternative medicine (CAM) and attitudes of a more holistic approach in general. Its aim was to understand both an individual's attitudes toward CAM and the role of a provider's communication with the patient and treatment approach. The items were framed in a seven-point, Likert-type rating scale format (1 = "absolutely disagree" to 7 =" absolutely agree"). The higher the score, the greater endorsement and more positive attitude towards CAM. In the CHBQ, three items were worded negatively to minimize acquiescence. The maximum possible score was 70 with a hypothetical midpoint of 35.

Utilization of FM/IFN (UFM/IFN)

In this section, the researcher created six FM/IFN questions to determine the utilization of these practices within my targeted population. These questions aimed to touch on the topics of high interest, such as, the use of dietary/herbal supplements, nutrigenomics, and complementary and alternative therapies for diabetes. In addition, they also provided details about the participant's current usage of vitamin, mineral, or herbal supplementation, along with their overall interest in nutrigenomics and utilization of CAM therapies.

Demographics

The last section of the questionnaire contained demographic questions. These questions were used to describe the characteristics of the sample that responded to the questionnaire. These questions included age, sex, ethnic background, education level, religion, and history of disease. In addition, participants were asked to insert their height and weight, which was then

used to calculate BMI status. Individuals who did not identify gender (male, female, or prefer not to answer) were excluded from the sex-specific results because their data could not be categorized for comparison.

Procedures

Email addresses were obtained through the University Provost's office. After receiving IRB approval, Kent State University faculty and staff of all campuses received the questionnaire through their work email account. The email included an explanation of the study and a link to the questionnaire and informed consent. Those who were willing to participate completed the initial informed consent form and then continued onto the questionnaire. The link to the questionnaire remained active for one weeks from the date of the original email request. The questionnaire started with informed consent, requiring them to agree to participate by clicking on the link to the questionnaire. Participants then began the Knowledge of FM/IFN section and answered eight questions about their prior knowledge of these two holistic treatment approaches. Following this section, participants took the CHBQ, which consisted of 10 questions regarding the participant's attitudes and beliefs of CAM and holistic approaches. These items were framed in a seven-point, Likert-type rating scale format (1 = "absolutely disagree" to 7 =" absolutely agree"). Next, participants then took the Utilization of FM/IFN questionnaire. This section contained six questions that were aimed to determine the participant's utilization of these practices. These questions provided details about the participant's current usage of vitamin, mineral, or herbal supplementation, along with their interest in nutrigenomics and utilization of CAM therapies. The final section of the questionnaire asked participants demographic questions. Participants responded with the sex with which they identify, age, ethnic background, education level, religion, and history of disease. In addition, they were also asked to insert their height and

weight, which then was used to calculate BMI status. Any data of individuals who indicated that they either had Type 1 or Type 2 DM were analyzed within the same group for their disease state. Participant responses were collected using Qualtrics XM, an electronic survey system.

Data Analysis

Data was analyzed using SPSS Version 25. Using standard units, data was uploaded into an excel sheet and a formula (BMI= (body weight in pounds/height in inches^2)*703) was used to calculate body mass index (BMI). Demographic data was analyzed using central tendencies, means and standard deviations, and frequencies. A t-test was run on the knowledge and beliefs means for those with and without diabetes to determine significance. The value of significance for these statistics was $p \leq .05$.

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Results

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A convenience sample of 617 faculty and staff members at a large university in Ohio responded to the email questionnaire. Once in the excel sheet, the responses of participants who failed to fully complete each component of the survey were eliminated. After elimination of unusable data, 427 responses were retained for analysis.

Kent State University Faculty and Staff Demographics

This questionnaire was sent to the faculty and staff of all eight campuses at Kent State University and demographic data was collected and analyzed as shown in Table 3. Of this sample, 115 people identified as male and 275 people as female. When asked about their primary role at Kent State University, the majority in both groups were staff members. In addition, the results revealed that the majority of individuals in both groups were Caucasian/White, had a Master's degree or higher, and were primarily Christian.

Table 3

Kent State University Faculty and Staff Participant Demographics in FM/IFN Research Study (Overall N=427)

	No Diabetes n	(%)	Diabetes n	(%)	Total
Gender					
Male	115	29.1	6	18.8	121
Female	275	69.6	26	81.3	301
Primary Role at KSU					
Faculty Member	188	47.6	13	40.6	201
Staff Member	207	52.4	19	59.4	226
Ethnicity					
Caucasian/White	347	87.8	28	87.5	375
African American/Black	15	3.8	2	6.3	17
Hispanic/Latino	6	1.5	0	0	6
Asian	6	1.5	0	0	6
Native American/Pacific Islander	1	0.3	1	3.1	1
Other/Unknown	6	1.5	0	0	6
Prefer not to answer	13	3.3	1	3.1	14
Education					
High school diploma or equivalent	5	1.3	0	0	5
Some college but no degree	20	5.1	2	6.3	22
Associate degree	11	2.8	1	3.1	12
Bachelor's degree	72	18.2	6	18.8	78
Master's degree	150	38	18	56.3	168
Ph.D./Terminal degree	137	34.7	5	15.6	142
Religion					
Christian	227	57.5	21	65.6	248
Judaism	9	2.3	1	3.1	10
Islam	1	0.3	0	0	1
Buddhism	6	1.5	0	0	6
Hinduism	3	0.8	0	0	3
Other	5	1.3	0	0	5

Note. Participants may have declined to share some aspects of their demographic data.

Table 4 shows that the average age of all participants was 50.3 years old. Participants without diabetes (*M*=50.5, *SD*= 11.6) were slightly older by a few years than those with diabetes (*M*=48.6, *SD*=12.6). The average participant BMI was 27.9 kg/m². Those with diabetes had a higher BMI (*M*=33.1, *SD*=6.4) than those without diabetes (*M*=27.5, *SD*=5.6).

Table 4

Adults With or Without Diabetes Demographics in FM/IFN Research Study (Overall N=369)

	n	Age (yrs)	Weight (lbs)	Height (in)	BMI (kg/m²)
Total	369	50.3±11.6	175.4±41.8	66.4±3.6	27.9±5.8
No Diabetes	340	50.5±11.6	198.9±36.3	66.3±3.6	27.5±5.6
Diabetes	29	48.6±12.6	166.1±40.4	67.3±3.6	33.1±6.4

Note. Participants may have declined to share some aspects of their demographic data.

Knowledge of FM/IFN and CHBQ Scores Between Those With and Without Diabetes

As seen in Table 5, the average knowledge of FM/IFN score was the same for both groups. For those who reported not having diabetes, the mean score was 5.7 (*M*=5.7, *SD*=1.4). For those with diabetes, the mean score was 5.7 (*M*=5.7, *SD*=1.2). The average CHBQ score for those without diabetes was 36.6 (*M*=36.6, *SD*=5.6) and 36.2 (*M*=36.2, *SD*=5.3) for those with diabetes.

Table 5

Knowledge of FM/IFN and Health Belief Scores of Those With and Without Diabetes (Overall N=427)

	n	Knowledge of FM/IFN Score	Health Belief Score
No Diabetes	395	5.7±1.4	36.6±5.6
Diabetes	32	5.7±1.2	36.2±5.3

Abbreviation. FM/IFN, Functional Medicine and Integrative and Functional Nutrition, CHBQ Complementary and Alternative Medicine Health Belief Questionnaire

Frequency of Participant Utilization of FM/IFN

Out of participants without diabetes who answered the question "Have you ever heard of FM/IFN?", the majority of respondents in both groups answered "no", as seen in Table 6. When participants without diabetes were asked if they felt as though FM/IFN techniques were effective in treating chronic disease, the majority in both groups responded "might or might not". Lastly, when asked the question "Have you ever met with a healthcare professional to discuss the relationship between nutrients, diet, and gene expression?", the majority in both groups answered

"No, I haven't and would be interested in doing so".

Table 6

Utilization of FM/IFN in Those With and Without Diabetes (Overall N=427)

	No Diabetes n	%	Diabetes n	%	Total
Have you ever heard of FM/IFN?					
Yes	111	28.1	12	37.5	123
No	284	71.9	20	62.5	304
Do you feel as though FM/IFN techniques are effective in treating chronic disease?					
Definitely yes	33	8.4	4	12.5	9.3
Probably yes	81	20.5	8	25	22.3
Might or might not	243	61.5	19	59.4	65.5
Probably not	8	2	0	0	2
Definitely not	4	1	0	0	1
Have you ever met with a healthcare professional to discuss the relationship between nutrients, diet, and gene expression?					
No, I haven't and would NOT be interested in doing so	96	24.3	9	28.1	105
No, I haven't and would be interested in doing so	216	54.7	18	56.3	234
Yes, I have	78	19.7	5	15.6	83

Note. Participants were permitted to select more than one response.

Utilization of CAM Methods Between Those With and Without Diabetes

As Table 7 shows, the participants were asked "If any, which CAM methods have you used to treat a chronic disease?". In both groups, meditation/yoga was the most used therapy, followed by massage therapy in those without diabetes. In those with diabetes, many participants answered, "I have never used any of these methods" as well.

Table 7

Utilization of CAM Methods in Those With and Without Diabetes (Overall N=427)

	No Diabetes n	(%)	Diabetes n	(%)
Dietary/Herbal Supplementation	0	0	0	0
Acupuncture	59	14.9	4	12.5
Massage Therapy	144	36.5	8	25
Meditation/Yoga	169	42.8	9	28.1
Other	29	7.3	3	9.4
I have never used any of these methods	118	29.9	9	28.1

Note. Multiple responses were possible. The most common reported CAM methods in those who indicated "other" were practices such as hypnotherapy, trigger point injections (TPI), chiropractic care, reiki, biofeedback, neurostructural integration technique (NST), and dry needling.

Utilization of Vitamin, Mineral, and/or Herbal Supplementation Between Those With and

Without Diabetes

Participants were asked to identify which vitamins, minerals, and/or herbal supplements that they consume three or more times per week. For vitamin supplementation, the majority of respondents in both groups reported that they mostly take a multivitamin and vitamin D. As for mineral supplementation, participants in both groups reported taking magnesium, calcium, and zinc the most. Lastly, the majority of the sample reported not taking any herbal supplements three or more times per week. Although, in those without diabetes, ginger, cinnamon, and garlic were the highest reported herbal supplements. In those with diabetes, cinnamon, curcumin, and garlic were the highest reported herbal supplements.

Table 8

Utilization of Vitamin, Mineral, and/or Herbal Supplementation in Those With and Without Diabetes (Overall N=427)

	No Diabetes n	(%)	Diabetes n	(%)
Vitamin/Fatty Acid Supplementation				
Multivitamin	179	45.2	17	54.8
Folate/Folic Acid	25	6.3	4	12.9
Biotin	36	9.1	6	19.4
Vitamin B12	68	17.2	8	25.8
Vitamin B Complex	74	18.7	4	12.9
Vitamin C	50	12.6	8	25.8
Vitamin D	155	39.1	20	64.5
Vitamin E	32	8.1	4	12.9
Omega-3 Fatty Acid	65	16.4	7	22.6
Omega-6 Fatty Acid	13	3.3	1	3.2
Other	4	1	1	3.2
I do not take any vitamins or fatty acid supplements	103	26	4	12.9
Mineral Supplementation				
Magnesium	69	17.4	8	25.8
Calcium	90	22.7	5	16.1
Iron	41	10.4	2	6.5
Zinc	57	14.4	5	16.1
Chromium	13	3.3	0	0
Other	1	0.3	0	0
I do not take any mineral supplements	0	0	0	0
Herbal Supplementation				
Ginger	42	10.6	2	6.5
Cinnamon	52	13.1	3	9.7
Milk Thistle	8	2	0	0
Fenugreek	2	0.5	0	0
Ginseng	7	1.8	0	0
Bitter Melon	1	0.3	1	3.2
Aloe Vera	2	0.5	0	0
Curcumin	34	8.6	3	9.7
Garlic	49	12.4	4	12.9
Holy Basil	6	1.5	0	0
Fig Leaf	1	0.3	0	0
Other	2	0.5	0	0
I do not take any herbal supplements	256	64.6	19	61.3

Note. Multiple responses were possible. The most common vitamin supplements reported under "other" included a prenatal vitamin and vitamin A. The most common mineral supplements mentioned were potassium, copper, iodine, and Celtic sea salt. The most common herbal supplements indicated were turmeric, St. John's Wort, olive leaf, black cohosh, saw palmetto, marshmallow root, California poppy, bergamot orange, and ginkgo biloba. Other notable reported supplements included a probiotic, coenzyme Q10, MCT oil, apple cider vinegar tablets, collagen powder, CBD oil, melatonin, and the amino acids: taurine, l-theanine, l-glutamine, l-lysine.

Discussion

The above results describe specific findings for this study. Previous research aligning with this study can be used to describe results.

Comparison of Knowledge of FM/IFN and Health Belief Scores

There was no significant difference in the scores of both the knowledge of FM/IFN and CHBQ between those with and without diabetes, thus rejecting both hypotheses 1 and 2. On the 8-item knowledge of FM/IFN questionnaire, those with and without diabetes both had an average score of 5.7. Research conducted by the National Center for Complementary and Integrative Health (NCCIH) suggests that roughly 40% of adults in the United States use health care approaches that are outside of the mainstream (Mahan & Raymond, 2017). Researchers have concluded that the use of functional medicine is greatest among women, people aged 30-69, and those with a higher education (Mahan & Raymond, 2017). In this study, the average age of all participants was approximately 50 years old and the majority of participants were female. In addition, most of the sample had a master's degree or higher. All of these factors align with the NCCIH's previous research, indicating that this sample population may likely already use FM/IFN approaches, thus having a greater knowledge of the specific modalities and treatments discussed in the questionnaire.

In addition, there is an increased availability of information on the internet in today's society. Many individuals may learn about FM/IFN via the internet for a variety of reasons. For example, an individual may be more inclined to look toward to a holistic health care approach if conventional medicine treatments were either too expensive or previously unsuccessful. Also, an increased contact with other cultures that traditionally use CAM would influence an individual's

knowledge of FM/IFN. Research by the NCCIH also found that Native Americans, Hawaiians, and Pacific Islanders typically report the highest use of functional medicine, followed by non-Hispanic whites (Mahan & Raymond, 2017). Although the majority of this sample was Caucasian/white (87.8%), participants may learn about FM/IFN through conversations with those of different ethnicities and cultures. By determining an individual's prior knowledge of FM/IFN, we can better understand the baseline knowledge of a population and determine a starting point for further education concerning FM/IFN.

As discussed before, the CHBQ scores between those with and without diabetes was not significant between those with or without diabetes. A higher score indicated a more positive outlook towards CAM modalities and treatments (max=70, midpoint=35). Overall, both CHBQ scores were close to the midpoint value, indicating an indifference to CAM practices among this sample. This may be attributed to the fact that many health care professionals are not properly educated on CAM techniques, thus most likely are not comfortable discussing these practices with their patients. Prior research shows that healthcare professionals, more specifically pharmacists and physicians, feel as though they currently lack the knowledge, confidence, and training to provide guidance to those who are interested in adopting CAM therapies (Ventola, 2010). This can be a major problem in regard to consumer acceptance and knowledge of CAM therapies because individuals may not have a reliable healthcare professional to turn to with any questions or concerns. As more research continues to prove that an increased number of Americans are utilizing CAM, health care professionals must be trained and educated on the various CAM treatments and practices in order to better guide and counsel their patients to make healthful decisions.

Frequency of CAM Utilization

The results of this section revealed that the majority of participants who completed this survey had never heard of FM/IFN before. This finding is interesting considering the scores of the knowledge of FM/IFN questionnaire between both groups were approximately 71%. Although the participants may have some type of prior knowledge of FM/IFN or CAM techniques, they may be lacking the understanding of the proper terminology of these approaches. In addition to this, the majority of the sample responded that FM/IFN techniques "might or might not" be effective in treating chronic disease. Also, when asked whether or not they would be interested in discussing the topic of nutrigenomics with a healthcare professional, most participants responded with "No, I haven't and would be interested in doing so". This can relate back to the lack of resources and training available to healthcare professionals regarding FM/IFN. In one survey, 76% of general practice physicians reported that they were "poorly informed" about herbal medicines and 46.6% claimed that their own knowledge was either "very poor" or "quite poor" (Ventola, 2010). In addition, 77.3% of respondents confessed that they feared their patients would take herbal supplements without telling them, yet only 12.9% reported that they "always" inquire about the use of any dietary supplements (Ventola, 2010). If physicians are not comfortable discussing alternative treatments with their patients, how can individuals feel comfortable reporting any CAM use or asking FM/IFN related questions? The results of this study reveal that there is a definite interest in wanting to learn more about FM/IFN within this population. Although the participant's desire to learn more about FM/IFN may be present, there is still a significant lack of FM/IFN education among healthcare professionals that is only furthering the gap between the proper knowledge and use of these practices.

When asked about CAM methods the participants have used to treat a chronic disease, zero participants reported any use of dietary/herbal supplements. This result is surprising because in those with diabetes, some participants indicated that they used cinnamon, garlic, and curcumin three or more times per week. For both groups, the majority of participants answered that they have used meditation/yoga in the past to manage their chronic illness. In those without diabetes, many individuals also utilized massage therapy. Practicing yoga can be important in preventing or managing a chronic disease, so it was interesting to see how frequently it is used. Yoga may help to redistribute body fat and reduce central obesity, which may often lead to insulin resistance. The dynamic stretching during yoga may initiate the rejuvenation of pancreatic cells, increase insulin secretion, and correct the impaired insulin-secretion in chronic diabetes (Shantakumari et al., 2013). As for meditation, researchers suggest that stress management may play a key role in the prevention and management of diabetes because of its role in regulating blood glucose levels and stress hormones, like adrenaline and cortisol. They concluded that meditation can suppress stress hormones, reduce sympathetic activity, and enhance parasympathetic activity, resulting in decreased blood pressure and plasma glucose levels (Chaiopanont, 2008). Yoga/meditation and massage therapy are widely accepted CAM treatments, so it isn't surprising that many of the participants has used these methods before.

Frequency of Vitamin, Mineral, and/or Herbal Supplementation Use

The utilization of FM/IFN questionnaire was developed by this researcher to get a better understanding of the current usage of specific CAM therapies among this population. The results of the current study indicated that the two most used vitamin supplements between both groups are a multivitamin and vitamin D. This aligns with a more recent study, in which the most commonly reported dietary supplements among American adults were multivitamins,

vitamin D, omega-3 fatty acids, vitamin B-complex, and vitamin B (Gahche et al., 2017). In addition, many individuals are instructed to take a multivitamin per their physician/healthcare provider and those residing in northern/midwestern states often supplement with vitamin D due to an overall lack of sunlight in the winter months.

In addition, there was a high reporting of calcium and some herbal supplementation use as well. In this research, calcium and magnesium were the two most common minerals used for those without diabetes. For those with diabetes, calcium, magnesium, and zinc were the most used supplements. These findings also are not surprising as some nutrients, such as vitamin D and calcium, are often paired up in supplements for better nutrient absorption. In addition, it's important to take the time period in which this survey was conducted into account as well. For example, zinc may be more used by participants during the COVID-19 global pandemic due to the well-known positive effect it has on the immune system. More healthcare providers may be suggesting supplements that boost immunity now more than ever, especially in those with a chronic disease.

As for herbal supplementation use, the majority of both groups reported not taking any type of herbal supplement on a regular basis. However, highest use of herbal supplements included cinnamon, garlic, and ginger among those without diabetes. In those with diabetes, garlic, curcumin, and cinnamon were the most noted. The use of these herbs in those with diabetes is understood as cinnamon is a widely used spice that is hypothesized to improve glucose control by phosphorylating insulin receptors, thus increasing insulin sensitivity (Venkatakrishnan, Chiu, & Wang, 2019). Cinnamon has an observed anti-diabetic effect as it can help to effectively regulate glucose homeostasis by increasing the insulin secretion of GLP-1 and the translocation of GLUT4 (Venkatakrishnan, Chiu, & Wang, 2019). In addition, garlic is

another common herb often mentioned in the management of diabetes for its various therapeutic properties, like antioxidant, anti-inflammatory, antihyperglycemic, and anticoagulant benefits. Many studies indicate that garlic acts to increase glucose utilization by upregulating the enzymes involved in glycolysis and glycogenesis (Venkatakrishnan, Chiu, & Wang, 2019). Turmeric's active component, curcumin, enhances insulin secretion and transportation. It is reported to inhibit beta cell apoptosis, emphasize glycolysis and beta oxidation, and inhibit insulin resistance and glucose reabsorption (Venkatakrishnan, Chiu, & Wang, 2019). Participants with and without diabetes may utilize these herbs for their known benefits, whether by taking them as a supplement or cooking with the spice itself. In the future, it would be interesting to further look into where individuals are getting their supplements from and the reasons they have for taking them.

Applications

The results gathered from this study can be used to determine a baseline knowledge of FM/IFN in this sample population, along with the desire to learn more about CAM therapies. Participants scored approximately a 71% on the knowledge of FM/IFN questionnaire, yet majority responded that they have never heard of FM/IFN before. This reveals a lack of education in regard to the terminology of FM/IFN. Many individuals within this sample may have a significant amount of FM knowledge and use of CAM therapies yet may be unaware that the practices are defined as either CAM or FM/IFN. Healthcare professionals can use this data to address the lack of proper terminology by educating other adults on these approaches and making sure they understand the full benefits and risks of adopting various FM/IFN practices.

In addition, the majority of this sample expressed a desire to talk more with a healthcare professional regarding the concept of nutrigenomics. This finding illuminates the need for more

education in the field of FM/IFN for registered dietitians, nutrition graduate students, and dietetic interns. As the population's interest of alternative medicine continues to increase, academic institutions must start to incorporate FM/IFN into their curriculum, clinical practice, and research. Previous studies show that individuals are often using CAM therapies in combination with conventional practices without discussing it with a healthcare provider first, which may do more harm than good. Academia must begin to offer more support for this type of education, research, and the integration of FM/IFN with conventional practices. Moving forward, registered dietitians must be prepared to discuss and give feedback on various CAM therapies, specifically on dietary and herbal supplementation use. More research and investigation is needed on the knowledge and beliefs of FM/IFN in healthcare professionals to determine whether or not they align with the increased interest of FM/IFN in the adult population.

Limitations

One limitation to the study is the use of self-reported data.   Participants may have responded in a way that they believe is socially desirable by the researchers, with no way to determine if these are their actual perceptions and behaviors. Another limitation is the wording of the questions in the utilization of FM/IFN questionnaire. For example, zero participants reported use of dietary/herbal supplements to treat chronic disease yet in those with diabetes, participants indicated that they used cinnamon, garlic, and curcumin three or more times per week. In addition, the amount of true or false questions could provide inaccurate data on the participant's overall knowledge. Without an "I don't know" option, respondents may be more knowledgeable than they appear. The final limitation of this study is the small, minimally diverse sample profile. For convenience purposes, the faculty and staff at Kent State University was

utilized for this study. However, a larger sample size could have generated more accurate results.

Conclusion

The scores on the knowledge of Functional Medicine/Integrative and Functional Nutrition (FM/IFN) questionnaire revealed that participants in both groups had an average score of 5.7 out of 8 points. As for the Complementary and Alternative Medicine Health Belief Questionnaire (CHBQ), participants in both groups scored approximately 36 points out of a possible 70. This indicates that this population may have a decent foundation of knowledge regarding FM/IFN already but are still unsure of whether or not these methods can be used to treat chronic illness. In addition, the majority of participants reported using a variety of CAM therapies, like meditation/yoga and acupuncture, but responded "no" when asked if they have heard of FM/IFN before. This shows that there is a strong need for more public education in regard to FM/IFN. With the increased interest for these two healthcare approaches in society today, healthcare professionals must first be educated on these practices so that they are more comfortable and confident in discussing them with their patients. Although in order for healthcare professionals to be more educated on FM/IFN, academic institutions must first begin to incorporate FM/IFN into their curriculum and offer more support for this type of education and research.

APPENDICES

APPENDIX A

RECRUITMENT EMAIL AND INFORMED CONSENT FORM

Recruitment Email:

Hi there,

My name is Michelle Yako and I am a graduate student studying nutrition at Kent State University. I am writing to you to ask you to complete an anonymous questionnaire, requiring only about 10 minutes of your time, to help me collect data for my master's thesis. This study will investigate the current knowledge, attitudes, and beliefs, along with utilization of the various practices of functional medicine (FM) and integrative and functional nutrition (IFN) among Kent State University's faculty, staff, and student employees. This questionnaire will ask questions regarding your feelings and knowledge of FM/IFN, followed up with demographic questions.

If you would like to participate in this questionnaire, please click the link on the bottom of the page.

If you have any questions, please e-mail me (myako1@kent.edu) or my thesis advisor, Dr. Amy Miracle (amiracle@kent.edu). Thank you in advance for your participation in this questionnaire. Your time and efforts are greatly appreciated!
Michelle Yako

Informed Consent Form:

Hi, thanks for your interest in taking this survey regarding the knowledge, attitudes, and beliefs of function medicine (FM) and integrative and functional nutrition (IFN). Before taking part in this study, please read the consent form below and click on the "I agree" button at the bottom of the page if you understand the statements and freely consent to participate in the study.

Consent Form:

This study involves a web-based survey designed to understand the knowledge, attitudes, and beliefs regarding FM and IFN of the faculty and staff at Kent State. The study is being conducted by Professor Dr. Amy Miracle and Michelle Yako, graduate student and dietetic intern, at Kent State University. It has been approved by the Kent State University Institutional Review Board. No deception is involved, and the study involves no more than minimal risk to participants. Participation in the study typically takes roughly 10 minutes and is strictly anonymous. Participants begin by completing the knowledge and attitudes sections regarding Complementary and Alternative Medicine (CAM) and FM/IFN. Next, participants will take the Health Belief Questionnaire (CHBQ) to evaluate the current beliefs towards CAM. In addition, there are seven questions regarding the utilization of FM/IFN. Lastly, participants will take a 9-question demographics survey before the questionnaire is completed. All responses are treated as confidential, and in no case will responses from individual participants be identified. Rather, all data will be pooled and published in aggregate form only. Participation is voluntary, thus participants may refuse to take the study or withdraw from the study at any point. If participants have further questions about this study or their rights, they may contact the principal investigator, Dr. Amy Miracle (amiracle@kent.edu) or Michelle Yako (myako1@kent.edu); or the Kent State University Institutional Review Board, at (330) 672-2704.

If you are 18 years of age or older, understand the statements above, and freely consent to participate in the study, click on the "I agree" button to begin the experiment.

APPENDIX B

KNOWLEDGE OF FM/IFN

Q87 Functional foods contain biologically active ingredients associated with physiological health benefits for preventing and managing chronic diseases, such as type 2 diabetes.

    o True (1)

    o False (2)

Q88 Drinking aloe vera juice can increase swelling and prolong the healing of wounds and injuries.

    o True (1)

    o False (2)

Q89 Ginger root has inflammatory properties and is linked to many gasto-intestinal side effects.

    o True (1)

    o False (2)

Q90 Acupuncture techniques may regulate blood sugar levels and aid in pain management.

    o True (1)

    o False (2)

Q91 Curcumin, which is found in the spice turmeric, has been shown to increase blood sugar levels and should not be used to manage type 2 diabetes.

    o True (1)

    o False (2)

Q92 Meditation is a new technique used in the treatment of type 2 diabetes, therefore there is not much available research on it.

    o True (1)

    o False (2)

Q93 Yoga is a type of exercise that helps to redistribute body fat and reduce central obesity.

    o True (1)

    o False (2)

Q94 Consuming 1 gram of cinnamon per day can increase insulin sensitivity.

o True (1)

o False (2)

APPENDIX C

COMPLEMENTARY AND ALTERNATIVE MEDICINE HEALTH BELIEF

QUESTIONNAIRE (CHBQ)

Q58 The physical and mental health are maintained by an underlying energy or vital force.

 o Absolutely agree (1)

 o Agree (2)

 o Somewhat agree (3)

 o Neutral (4)

 o Somewhat disagree (5)

 o Disagree (6)

 o Absolutely disagree (7)

Q59 Health and disease are a reflection of balance between positive life-enhancing forces and negative destructive forces.

 o Absolutely agree (1)

 o Agree (2)

 o Somewhat agree (3)

 o Neutral (4)

 o Somewhat disagree (5)

 o Disagree (6)

 o Absolutely disagree (7)

Q60 The body is essentially self-healing and the task of a health care provider is to assist in the healing process.

 o Absolutely agree (1)

 o Agree (2)

 o Somewhat agree (3)

 o Neutral (4)

 o Somewhat disagree (5)

 o Disagree (6)

 o Absolutely disagree (7)

Q61 A patient's symptoms should be regarded as a manifestation of a general imbalance or dysfunction affecting the whole body.

 o Absolutely agree (1)

o Agree (2)

o Somewhat agree (3)

o Neutral (4)

o Somewhat disagree (5)

o Disagree (6)

o Absolutely disagree (7)

Q62 A patient's expectations, health beliefs and values should be integrated into the patient care process.

o Absolutely agree (1)

o Agree (2)

o Somewhat agree (3)

o Neutral (4)

o Somewhat disagree (5)

o Disagree (6)

o Absolutely disagree (7)

Q63 Complementary therapies are a threat to public health.

o Absolutely agree (1)

o Agree (2)

o Somewhat agree (3)

o Neutral (4)

o Somewhat disagree (5)

o Disagree (6)

o Absolutely disagree (7)

Q64 Treatments not tested in a scientifically recognized manner should be discouraged.

o Absolutely agree (1)

o Agree (2)

o Somewhat agree (3)

o Neutral (4)

o Somewhat disagree (5)

o Disagree (6)

o Absolutely disagree (7)

Q65 Effects of complementary therapies are usually the result of a placebo effect.

o Absolutely agree (1)

o Agree (2)

o Somewhat agree (3)

o Neutral (4)

o Somewhat disagree (5)

o Disagree (6)

o Absolutely disagree (7)

Q66 Complementary therapies include ideas and methods from which conventional medicine could benefit.

o Absolutely agree (1)

o Agree (2)

o Somewhat agree (3)

o Neutral (4)

o Somewhat disagree (5)

o Disagree (6)

o Absolutely agree (7)

Q67 Most complementary therapies stimulate the body's natural therapeutic powers.

o Absolutely agree (1)

o Agree (2)

o Somewhat agree (3)

o Neutral (4)

o Somewhat disagree (5)

o Disagree (6)

o Absolutely disagree (7)

APPENDIX D

UTILIZATION OF FM/IFN (UFM/IFN)

Q116 Have you ever heard of FM/IFN?

　o Yes (1)

　o No (2)

Q117 Do you feel as though FM/IFN techniques are effective in treating chronic disease?

　o Definitely yes (1)

　o Probably yes (2)

　o Might or might not (3)

　o Probably not (4)

　o Definitely not (5)

Q78 Which vitamins/fatty acid supplements do you consume three or more times per week? Please check all that apply.

　☐　　　　Multivitamin (1)

　☐　　　　Folate or folic acid (2)

　☐　　　　Biotin (3)

　☐　　　　Vitamin B12 (4)

　☐　　　　Vitamin B complex (5)

　☐　　　　Vitamin C (6)

　☐　　　　Vitamin D (7)

　☐　　　　Vitamin E (8)

　☐　　　　Omega-3 (9)

　☐　　　　Omega-6 (10)

　☐　　　　Other: (11) _____

　☐　　　　I do not take any vitamins or fatty acid supplements (12)

Q79 Which mineral supplements do you consume three or more times per week? Please check all that apply.

　☐　　　　Magnesium (1)

☐   Calcium (2)

☐   Iron (3)

☐   Zinc (4)

☐   Chromium (5)

☐   Other: (6) _____

☐   I do not take any mineral supplements (7)

Q84 Which herbal supplements do you consume three or more times per week? Please check all that apply.

☐   Ginger (1)

☐   Cinnamon (2)

☐   Milk thistle (3)

☐   Fenugreek (4)

☐   Ginseng (5)

☐   Bitter melon (6)

☐   Aloe vera (7)

☐   Curcumin (8)

☐   Garlic (9)

☐   Holy basil (10)

☐   Fig leaf (11)

☐   Other: (12) _____

☐   I do not take any herbal supplements (13)

Q80 Have you ever met with a healthcare professional to discuss the relationship between nutrients, diet, and gene expression?

o No, I haven't and would NOT be interested in doing so (1)

o No, I haven't and would be interested in doing so (2)

o Yes, I have (3)

Q82 If any, which CAM methods have you used to treat a chronic disease? Please check all that apply.

☐   Dietary/herbal supplementation (1)

☐   Acupuncture (2)

☐   Massage therapy (3)

☐   Meditation/yoga (4)

☐   Other: (5) _____

☐   I have never used any of these methods (6)

APPENDIX E

DEMOGRAPHIC INFORMATION

Q115 What is your primary role at Kent State University?

○ Faculty member (1)

○ Staff member (2)

○ Student employee (3)

Q68 What is your age?

_____

Q73 What gender do you identify with?

○ Male (1)

○ Female (2)

○ Other: (3) _____

○ Prefer not to answer (4)

Q69 Please specify your ethnicity.

○ Caucasian (1)

○ African-American (2)

○ Latino or Hispanic (3)

○ Asian (4)

○ Native American (5)

○ Native Hawaiian or Pacific Islander (6)

○ Other/Unknown (7)

○ Prefer not to answer (8)

Q70 What is your completed highest level of education?

○ Less than a high school degree (1)

○ High school degree or equivalent (e.g., GED) (2)

○ Some college but no degree (3)

○ Associate degree (4)

o Bachelor's degree (5)

o Master's degree (6)

o Ph.D or terminal degree (7)

Q74 If applicable, please specify your religion.

o Christian (1)

o Judaism (2)

o Islam (3)

o Buddhism (4)

o Hinduism (5)

o Other: (6) _____

o N/A (7)

Q75 Please mark all chronic disease(s) that you have been diagnosed with by a healthcare professional.

☐   Heart Disease (1)

☐   Stroke (2)

☐   High Cholesterol (3)

☐   High Blood Pressure (4)

☐   Cancer (5)

☐   Anxiety (6)

☐   Depression (7)

☐   COPD or Chronic Lung Disease (8)

☐   Alzheimer's Disease (9)

☐   Type 1 Diabetes (10)

☐   Type 2 Diabetes (11)

☐   Chronic Kidney Disease (12)

☐   Food allergies: (13) _____

☐   None of the above (14)

Q76 The following questions will be used to calculate BMI. Please answer:
What is your current height (in feet and inches)? (1)

▼ 4'8" (1) ... 7'0" (29)

Q78 What is your current weight (in pounds)?

_____

APPENDIX F

ATTITUDES TOWARD CAM

Q95 Complementary and Alternative Medicine (CAM) is the term for medical products and practices that are not part of standard medical care. Examples may include homeopathy, naturopathy, massage therapy, and acupuncture.
CAM is just as effective at treating physical ailments as medications prescribed by medical doctors.

- o Strongly Disagree (1)
- o Disagree (2)
- o No opinion (3)
- o Agree (4)
- o Strongly Agree (5)

Q96 Positive thinking can assist in improving minor illnesses.

- o Strongly Disagree (1)
- o Disagree (2)
- o No opinion (3)
- o Agree (4)
- o Strongly Agree (5)

Q97 Symptoms of psychological disorders such as depression and anxiety can be improved by the practice of yoga.

- o Strongly Disagree (1)
- o Disagree (2)
- o No opinion (3)
- o Agree (4)
- o Strongly Agree (5)

Q98 CAM only works because of the placebo effect (people believe they will improve, so they do).

- o Strongly Disagree (1)
- o Disagree (2)
- o No opinion (3)
- o Agree (4)

o Strongly Agree (5)

Q99 CAM is better for your body than pharmacological drugs.

  o Strongly Disagree (1)

  o Disagree (2)

  o No opinion (3)

  o Agree (4)

  o Strongly Agree (5)

Q100 CAM should only be used after conventional medicine has shown little benefit.

  o Strongly Disagree (1)

  o Disagree (2)

  o No opinion (3)

  o Agree (4)

  o Strongly Agree (5)

Q101 A person's psychological state influences his or her physical health.

  o Strongly Disagree (1)

  o Disagree (2)

  o No opinion (3)

  o Agree (4)

  o Strongly Agree (5)

Q102 Yoga, deep breathing, or natural products can improve the symptoms of psychological conditions such as depression and anxiety.

  o Strongly Disagree (1)

  o Disagree (2)

  o No opinion (3)

  o Agree (4)

  o Strongly Agree (5)

Q103 CAM has fewer side effects than conventional medicines.

o Strongly Disagree (1)

o Disagree (2)

o No opinion (3)

o Agree (4)

o Strongly Agree (5)

Q104 A strong mind-body connection helps facilitate healing and strengthening of the immune system.

o Strongly Disagree (1)

o Disagree (2)

o No opinion (3)

o Agree (4)

o Strongly Agree (5)

Q105 Regular practice of yoga can do nothing for psychological conditions such as depression and anxiety.

o Strongly Disagree (1)

o Disagree (2)

o No opinion (3)

o Agree (4)

o Strongly Agree (5)

Q106 I will not use CAM until it is subject to more rigorous scientific testing.

o Strongly Disagree (1)

o Disagree (2)

o No opinion (3)

o Agree (4)

o Strongly Agree (5)

Q107 A person's spiritual beliefs play an important role in the healing process.

o Strongly Disagree (1)

o Disagree (2)

o No opinion (3)

o Agree (4)

o Strongly Agree (5)

Q108 Using alternative methods, the body has the ability to heal itself without pharmacological drugs.

o Strongly Disagree (1)

o Disagree (2)

o No opinion (3)

o Agree (4)

o Strongly Agree (5)

Q109 The physician who uses CAM will have more success with helping a patient's medical concern.

o Strongly Disagree (1)

o Disagree (2)

o No opinion (3)

o Agree (4)

o Strongly Agree (5)

Q110 Physicians should counsel patients on good nutritional habits to prevent chronic illness.

o Strongly Disagree (1)

o Disagree (2)

o No opinion (3)

o Agree (4)

o Strongly Agree (5)

Q111 CAM should be used in conjunction with conventional medicines for the best patient outcome.

o Strongly Disagree (1)

o Disagree (2)

o No opinion (3)

o Agree (4)

o Strongly Agree (5)

Q112 People with psychological conditions, such as depression and anxiety, should implement a form of yoga practice or deep breathing exercises into their everyday lives to improve their symptoms.

o Strongly Disagree (1)

o Disagree (2)

o No opinion (3)

o Agree (4)

o Strongly Agree (5)

Q113 Using natural products can improve psychological health.

o Strongly Disagree (1)

o Disagree (2)

o No opinion (3)

o Agree (4)

o Strongly Agree (5)

Q114 Health encompasses more than just physical aspects-- mental and spiritual aspects also need to be taken into consideration for wellness.

o Strongly Disagree (1)

o Disagree (2)

o No opinion (3)

o Agree (4)

o Strongly Agree (5)

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