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Doctors & Diets: The Return of Nutrition to American Medical Education

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Doctors & Diets: The Return of Nutrition to American Medical Education

By

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Thesis Summary

The purpose of this honors graduation thesis is to analyze the role of nutrition in the prevention, management, and treatment of chronic diseases and to argue that clinical nutrition should be reintegrated into American medical education as a high priority subject. The thesis begins with a historical review of clinical nutrition beginning in the fifth century B.C. with Hippocrates in Classical Greece and ending in 21st century America. Following the historical review, five of some of the most prevalent chronic diseases in America are examined through a nutritional lens. This thesis concludes with a discussion of the outlook of American medical education as it relates to Culinary and Lifestyle Medicine programs.

Nutrition in American Medical Education: A Historical Review

For many, the idea that what we eat influences our health comes naturally. After all, our very survival depends on a well-rounded, nutritious diet. As early as the fifth century B.C., medical practitioners recognized this relationship and considered diet one of the most important indicators of one's health. Yet, modern Western medicine, specifically American medicine, excludes nutrition from most of its education and practice. One might predict that advances in medical science have simply outpaced our understandings of nutrition and that modern food technology deems nutrition's inclusion in medicine as unnecessary. In some ways, this is true as healthcare providers and public health officials use food technologies to combat numerous deficiency diseases. But as researchers continue to advance medical knowledge today, so too do researchers working in the field of nutrition science. Sometime in the last two millennia, the two formerly closely tied fields of nutrition and medicine became disconnected. While nutrition science has continually advanced in tandem with medicine since the end of the fifth century B.C., its integration in American medical education was fatally disrupted in the second half of the 20th century, and its reintegration is vitally important.

To understand the relationship between nutrition and medicine, one must examine the beginning of Western medicine itself. Widely agreed as the founder of Western medicine—hereby referred to simply as "medicine"—and the greatest physician of his time, Hippocrates practiced in Classical Greece with a foremost focus on the patient's diet. The *Hippocratic Corpus*, a collection of medical works authored by Hippocrates and his followers, contains dozens of treatises that ultimately laid the foundation of modern medicine. One of those treatises, "Tradition in Medicine" examines the connection between medicine and a proper diet. The

author explained that centuries of human experimentation have yielded a unique diet that is both nutritious and easily digestible. He even likened these early discoverers to physicians:

> What then is the difference in intention between the man who discovered the mode of life suitable for the sick, who is called a physician…and him who, from the beginning, discovered the way to prepare the food we eat now instead of the former wild and animal-like diet? … The one sought to do away with those articles of diet which…the human frame could not digest, and one which it could not remain healthy; the other discovered what a sick man could not digest in view of his particular malady. What difference is there save in the appearance, and that the one is more complicated and needs more study? Indeed, one is the forerunner of the other. (Hippocrates et al., 430-330/1983, p. 74)

Clearly, Hippocrates appreciated his ancestors' contributions, upon which he expanded to address the relationship between diet and the sick.

He explained that medicine was founded "because sick men did not get well on the same regimen as the healthy…if sick men fared just as well eating and drinking and living exactly as healthy men do…there would be little need for the science" (p. 71). With nutrition as an integral part of the science of medicine at the time, Hippocrates argued that a good diet contributes to one's health, while a poor diet contributes to one's discomfort or illness. This dependence implies that diet may be used as a therapy to restore one's well-being. Hippocrates asserted this point when he explained the invention of gruel. As a mixture of food and water, gruel was used as a source of sustenance for the sick who were unable to keep down normal solid food. He explained that although gruel provided nourishment for some, it did not benefit all, writing, "It must be clearly understood, however, that gruel is not necessarily of assistance to everyone who

is sick. In some disease it is evident that on such a diet, the fever and pains increase, the gruel serving as nourishment to the disease, but as a source of decline and sickness to the body" (p. 73). As with all therapies, we see here that clinical nutrition has its limits.

Hippocrates also advocated that diet may be used for more than disease recovery and prevention. He described how diet may increase one's athletic performance with, "The discoveries of medicine are of great importance and are the result of thought and skill on the part of many people. For instance, even now trainers in athletics continue to make discoveries…[about] what men must eat and drink to gain the greatest mastery over their bodies and to achieve the maximum strength" (p. 73). As seen here, even exercise science and performance nutrition have roots in the Classical Greek understanding of diet.

The diet section of "Traditions in Medicine" concludes with an early opinion on food-related diseases. Hippocrates (430-330/1983) observed that individuals digest certain foods, such as cheese, with varying degrees of success:

> Some can eat their fill of it without any unpleasant consequences and those whom it suits are wonderfully strengthened by it. On the other hand, there are some who have difficulty in digesting it. There must, then, be a difference in their constitutions and the difference lies in the fact that, in the latter case, they have something in the body which is inimical to cheese and this is aroused and disturbed by it. (p. 84)

He later attributed these differences to humoral imbalances, which reflects the prevailing humoral theory. Humoral theory directed medical thought for over 2000 years before being superseded by more modern theories such as the germ theory, metabolic, genetic, and other

theories of disease. Still, this excerpt exists as an early observation of a food-related disease, lactose intolerance.

While Hippocrates laid the foundation of modern medicine as early as the fifth century B.C., clinical nutrition was not widely revisited until the 18th century A.D., evident by the sparse publication of medical and nutrition research.

Scholars argue that European researchers revived the interest in nutrition research beginning with the 1785 report by French scientist, Claude Berthollet. The late Kenneth Carpenter, Professor of Experimental Nutrition at the University of California, Berkeley, wrote that Berthollet's discovery of the presence of ammonia in decomposing animal matter and its chemical composition sparked the so-called "Chemical revolution" in Europe (Carpenter, 2003, p. 638). Other scientists soon confirmed these results and nitrogen research quickly came to dominate nutrition science through the early 19th century. For example, researchers such as François Magendie and, later, Jean Baptiste Boussingault sought to determine relative nutritional values of various foods through their nitrogen concentrations. Their logic suggested that because animals contain high concentrations of nitrogen, as Berthollet concluded, the food they consume must be the source. This logic was supported by Magendie's own work with dogs, to which he exclusively fed one nutritious food item (sugar, butter, gum, or olive oil) that did not contain much nitrogen. He found that the dogs did not survive long on only one food item. Magendie eventually concluded that foods high in nitrogen were necessary to sustain the dogs and presumably humans. Though later proven incorrect, his logic did yield a valuable conclusion that modern dieticians still praise: a balanced diet containing a variety of nutritious foods is necessary to maintain health and prevent disease (Carpenter, 2003, p. 639).

Nutrition remained an essential field of scientific research and was dominated by European researchers throughout the 19th century. In addition to working on protein requirements and digestion, they first addressed deficiency diseases, such as scurvy (vitamin C) and goiter and cretinism (iodine). American contributions at this time were limited, focusing mainly on digestion, and were generally overshadowed by those of the Europeans (Carpenter, 2003, pp. 643-5). This lack of American involvement in the field translated to an absence of nutrition in American medical education until the early 20th century. The sparse literature on this subject suggests that clinical nutrition had not yet disseminated into American medical schools' curricula.

Despite its absence in medical education, American researchers in nutrition science expanded their understanding of protein, calorimetry, and deficiency diseases through the late 19th century and into the early 20th century. This period continually saw conflicting ideas about protein as researchers debated its importance as an indicator for health and productivity. These debates spurred further research into required daily intake and alternative sources besides meat. Wilbur Atwater, an American chemistry professor involved in this debate in the late 19th century, sought to increase the affordability of protein sources for poor Americans. In the process, he first determined the energy values of the macronutrients (carbohydrates, protein, and fat) using calorimetry. Arguably his most significant contribution to the field, these values have stood the test of time as one of the most important early American contributions to nutrition science (Carpenter, 2003, pp. 975-7).

In addition to new understandings of protein and calorie requirements, the turn of the century saw an expanded knowledge of deficiency diseases. While researchers continually studied scurvy, goiter, and cretinism, they also began examining others, such as anemia (vitamin

B-12), beriberi (vitamin B_1), rickets (vitamin D), and night blindness and xerophthalmia (vitamin A). Although the diseases themselves were identified, many were not well understood until the discovery of vitamins several decades later. The realization that these new diseases could be treated and cured by altering diets quickly motivated reformers to criticize the state of American medical education as early as 1902. For example, W.G. Thompson of the Cornell University Medical College reported with concern the following:

> The subject of the dietetic treatment of disease has not received the attention in medical literature which it deserves, and it is to be regretted that in the curriculum of medical colleges it is usually either omitted or is disposed of in one or two brief lectures…One cannot fail to be impressed with the meager notice given to the necessity of feeding patients properly, and the subject is usually dismissed with brief and indefinite phrases such as: "the value of nutritious diet requires more mention, ... a proper but restricted diet is recommended," or "the patient should be carefully fed" (National et al., 1985, pp. 9-10).

This excerpt comes from the Committee on Nutrition in Medical Education's 1985 report on the state of nutrition in U.S. medical education. The committee, led by its chairman Myron Winick under the authority of the Food and Nutrition Board of the National Research Council, began with a short historical analysis of nutrition in U.S. medical education. The bulk of the report, however, focused on the current state of American medical education and recommendations for improvement.

As mentioned in the report, classifications of deficiency diseases in the late 19th and early 20th centuries prompted subsequent research into the actual substances, the lack of which caused

the diseases. We know many of these substances as vitamins and minerals today. Commonly known as the golden age of nutrition, the period between 1913-1948 included the age of discovery of the vitamins and a surge in nutrition education in U.S. medical schools. Elmer McCollum combined these trends, both as a pioneering vitamin researcher and advocate for the teaching of clinical nutrition. Medical schools across the country selected his textbook, *Newer Knowledge in Nutrition* (1918), and continued to emphasize his and others on nutrition through the 1930's (National et al., 1985, p. 10).

The adoption of nutrition education materials by U.S. medical schools in the early 20th century served as the first substantial development of clinical nutrition education since the *Hippocratic Corpus*, over 2000 years prior. This development was encouraged by the American Medical Association and similar organizations in the United States. The AMA Council on Medical Education and Hospitals, like Winick's committee, examined nutrition's role in medical education. Their studies showed that the vast majority of American medical schools in the 1930's offered biochemistry courses with specific interest in clinical nutrition (National et al., 1985, p. 11). However, this brief interest began to fade by the end of the 1940's.

The discovery of vitamin B-12 in 1948 essentially concluded the age of discovery of the vitamins. Soon, the combination of decreasing concern for deficiency diseases in public health and the rise of food technologies, such as fortification and supplementation, drove medical schools to remove nutrition as a high priority subject. It became fragmented and integrated into other courses in the 1950's and 1960's; a 1958 survey of American medical schools found that only 20% offered a course in nutrition, demonstrating its now reduced status (National et al., 1985, pp. 12-3). Formal attempts by professional organizations and the U.S. government in the

1960's to address physicians' inadequate knowledge of nutrition also show that the shift away from clinical nutrition was indeed legitimate. For example, the 1963 AMA Council on Foods and Nutrition led the Chicopee Conference, which gathered ideas and recommendations by physicians, scientists, and administrators for improving nutrition education. Some of these recommendations included increased funding by industry and government for nutrition research and education; establishment of committees by medical schools to develop nutrition programs; and internship and residence programs that focus on clinical nutrition. Similarly, in 1969, a Senate subcommittee and a White House conference separately concluded that medical schools should increase funding for nutrition programs. Nevertheless, the early 1970's brought little progress in medical students' knowledge of nutrition and establishment of separate nutrition programs and faculty positions (National et al., 1985, pp. 13-4).

Based on the 1985 report by Winick's Committee on Nutrition in Medical Education, this lack of progress continued for at least another decade. Through a survey using mailed questionnaires and telephone interviews, the committee contacted a representative sample of 39 of the 127 accredited medical schools in the United States. The survey sought to determine several characteristics of the schools' nutrition programs, including the existence of a separate course, hours devoted to its instruction, and the specific topics covered in the curricula, among others (National et al., 1985, pp. 60-1). The committee provided extensive analysis of the survey responses in the report, the general trends were as follows: a minority of medical schools offered a separate nutrition course; hours devoted to nutrition instruction were distributed unevenly across medical schools; and successful nutrition programs employed both M.D. and Ph.D. faculty.

With data pulled directly from survey responses, the committee reported, “Nutrition is taught, at least in part, as a separate course in 33% of the schools that reported teaching nutrition in the required curriculum. Only 18% of the schools reported that nutrition is taught entirely as a separate, free-standing course” (p. 63). As medical schools shifted away from separate courses, they began offering elective courses as a replacement. The committee found that, “Elective courses in nutrition were reportedly offered in 64% of the 39 schools…[but] less than 33% of medical students take nutrition electives,” indicating that these elective courses served as an inferior replacement that benefitted a minority of students (pp. 63-4).

As with the data on the lack of separate nutrition courses, the same conclusion can be made from data on the hours of nutrition instruction offered: nutrition remained a low priority for American medical schools as late as 1985. Winick and his team reported that, “the distribution of nutrition teaching time among schools is not symmetrical: 20% of schools teach less than 10 hours, 59% teach less than 20 hours, 30% teach 30 hours or more, and 10% teach 40 hours or more” (p. 62). Based on estimates by staff at each medical school, the report explained that these hours were mostly found woven into other courses. Like elective courses, integrated nutrition instruction benefited a minority of students as medical schools continued to deem it a low priority subject.

The relegation of the nutrition education to a low priority occurred despite existing need in education and practice for physicians with clinical nutrition knowledge. Winick’s committee also examined the faculty members involved with nutrition education as part of its analysis of U.S. medical schools. The committee found that physicians play an essential role in instruction

and, arguably more importantly, in clinical application. The committee wrote the following about effective nutrition programs:

> Effective integration of nutrition into the clinical training of medical students depends on the active participation of M.D. as well as Ph.D. faculty members. Physicians who are knowledgeable about nutrition are convincing role models because they are able to demonstrate the application of nutrition in clinical practice. [In] all the well-established nutrition programs evaluated in detail by the committee, physicians play an active role, even when faculty with Ph.D.s from basic science departments are responsible for organizing the curriculum. Furthermore, although dietitians and pharmacists are also involved in teaching nutrition principles, the committee's consultants stressed that their impact is limited unless there is a physician who is responsible for instruction and participates on the team that provides nutritional care. (p. 66)

Yet, as survey results showed, "…schools acknowledged a marked shortage of faculty members with adequate backgrounds for teaching nutrition" (p. 66). We see here that the reduction of nutrition's status in medical education negatively impacts both present and future medical students. Without quality instruction, today's graduates are less able to incorporate nutrition into their practice, which limits their abilities to mentor future students.

The committee concluded its report with several recommendations, both broad and specific, that aim to "improve current nutrition programs in U.S. medical schools" (p. 95). Namely, the committee stated which topics should be covered in the recommended minimum of 25-30 hours of nutrition instruction, in addition to emphasizing that electives and postgraduate training reinforce these topics. The committee also recommended that medical schools employ

an active physician with an interest in clinical nutrition to lead and develop their nutrition programs. This, plus the creation of research programs and separate nutrition departments, should complement instruction and ensure longevity. Echoing the 1963 Chicopee Conference, the committee finally called for increased funding from government and private institutions to advance teaching and materials and educate nutritional scientists (pp. 96-8).

With clearly outlined recommendations and defined needs, one might expect much progress to be made since the publishing of the Committee on Nutrition in Medical Education's 1985 report. However, a similarly structured review from 2006 reports that nutrition programs in U.S. medical schools have not significantly improved. Conducted by the Department of Nutrition at the University of North Carolina at Chapel Hill, the review tells an almost identical story to Winick's report from twenty years earlier. The 2006 review reports that "less than one-half of the responding schools provided the minimum 25 [hours of nutrition education]" and that "roughly 60-80% of schools are teaching far less nutrition than is recommended" (Adams et al., 2006, pp. 942-3). Nutrition remains a low priority in medical education, despite persisting needs. Problems with training medical students still exist and growing research on nutrition's role in chronic diseases indicate an increasing demand for medical schools to reform their curricula. And from the physicians' points of view, their experiences with nutrition in their medical education are consistent with the literature. Numerous physicians recall that their nutrition education was limited to the inpatient setting, scattered and rushed, or even non-existent (S. Tilden, personal communication, March 2, 2022; M. Clary, personal communication, March 23, 2022; C. Reilly-Torres, personal communication, March 2, 2022; L. Platt, personal communication March 21, 2022).

Practicing in a variety of fields, these physicians report that they usually lead the discussion about nutrition when speaking with their patients, which suggests that nutrition is not in the forefront of most patients' minds (S. Tilden, personal communication, March 2, 2022; C. Reilly-Torres, personal communication, March 2, 2022; L. Platt, personal communication March 21, 2022; M. Clary, personal communication, March 23, 2022). This should concern both healthcare providers and administrators considering rising rates of chronic diseases, such as heart disease, cancer, obesity, and diabetes, to name a few, are responsible for millions of American deaths every year, with heart disease and cancer as the leading causes (CDC, Oct. 2021). Many of these diseases are—at least partially—preventable with proper nutrition practices. Nutrition's role in preventing America's most effective killers is well documented, but today's physicians and medical students are largely unprepared to counsel their patients about their specific nutritional needs (Adams, 2006, p. 943). To support these ideas, the following section aims to provide evidence linking nutrition with five of America's most prevalent, and often fatal, chronic diseases: heart disease, hypertension, diabetes, cancer, and obesity.

Nutrition-Related Diseases

Heart Disease

The term “heart disease”, also known as coronary artery disease or atherosclerosis, falls under the greater umbrella of cardiovascular disease, a grouping of diseases affecting the heart and blood vessels. According to the Centers for Disease Control and Prevention (2022), heart disease is the leading cause of death among Americans, including men, women, and most racial and ethnic groups. Tens of millions of Americans currently suffer from heart disease, while hundreds of thousands die from it every year. Several medical conditions and behaviors increase one’s risk of heart disease, such as hypertension, diabetes, overweight and obesity, diet, exercise, and substance use (CDC, 2022). Physicians often focus on some of these risk factors more than others, namely the diagnosable medical conditions over the lifestyle behaviors, like nutrition.

Researchers interested in clinical nutrition, including numerous physicians, recognize that nutrition is a major risk factor as some estimate that approximately 72% of cardiovascular deaths are related to diet (Bowen et al., 2018). These high (and increasing) morbidity and mortality rates may serve as telling consequences of the relegation of nutrition to a low priority subject in American medical education. Indeed, such statistics suggest that today’s physicians are losing the battle against heart disease. But, with the help of clinical nutrition researchers and medical school administrators, physicians could soon find the key to effective therapies. Researchers have identified relationships between heart disease and intake of various lipoproteins, such as LDL and HDL cholesterol; dietary fats like saturated fatty acids, monounsaturated fatty acids, *trans* fatty acids, and polyunsaturated fatty acids; and amino acids like homocysteine (Schaefer, 2002, pp. 193-198). In addition, others have published connections to sodium, to high-density

(especially water-soluble) fiber, and, more generally, to fruits and vegetables (Bazzano, 2002; Bazzano 2003; Bowen, 2018).

While some of these findings offer novel connections between heart disease and nutrition, many points merely update existing clinical nutrition knowledge and dietary guidelines and recommendations. That is not to say that current clinical nutrition research is not necessary or useful, but rather it supports the point that the data exists, and has existed for many years, but is not being used as effectively as possible. At the same time, we can not blame physicians wholly for the current state of heart disease in America. As researchers build upon current nutrition knowledge, those responsible for issuing dietary guidelines must continually change their recommendations. As clinical nutrition expands, these guidelines have grown in number, sometimes offering conflicting advice. For example, Bowen et al. (2018) summarized eight different dietary guidelines, ranging from the United States Department of Agriculture to the World Health Organization (pp. 3-4). Several recommendations directly conflict with each other, such as the recommended daily allowance of saturated fats and specific foods like vegetables and dairy products. It should not be surprising that physicians have struggled to control heart disease when they must sort through an ever-evolving pool of research and guidelines. Again, integrating nutrition as a high priority subject in American medical education would prove beneficial as it filters the plethora of clinical nutrition research and standardizes dietary therapies backed by clinical research. This would also reduce the need for physicians to conduct their own research, which places undue strain on their already busy schedules. Based on some of my own conversations with both primary care physicians and specialists, much of their knowledge of nutrition originates from their own research efforts. When I spoke with Dr. Samuel Tilden, a family practice physician in Western North Carolina, about this, he explained that he feels

confident about counseling his patients about nutrition because of his own individual research over the past several years. He also reported that he encourages his patients to do their own nutrition research (S. Tilden, personal communication, March 2, 2022). However, this brings its own set of concerns as patients may be ill-equipped to differentiate between trustworthy and unreliable sources of nutrition knowledge.

Hypertension

As a risk factor for heart disease, hypertension describes the state of high blood pressure, or the pressure that blood exerts on the arteries. Nearly half of Americans have hypertension or take medications for it, according to the CDC (Sept. 27, 2021), making it one of the most prevalent, yet manageable diseases in the country. Physicians may also diagnose hypertension as an isolated disease and treat it with a variety of therapies.

In addition to blood-pressure-lowering medications, physicians may treat hypertension with diet and exercise. Researchers have shown that nutrition can play a significant role in one's risk for hypertension as was the case for heart disease. Also, researchers have demonstrated in the dietary approaches to stop hypertension (DASH) trials that nutrition can reverse the disease by reducing systolic and diastolic pressure in individuals with and without hypertension. The well-known DASH diet emphasizes fruits, vegetables, low-fat dairy products, whole grains, nuts, and fish, while limiting the intake of red meat and products containing sugar. Variations of the DASH diet have demonstrated similar results, indicating that a variety of dietary options exist for hypertension management and treatment (Reddy & Katan, 2007, pp. 178-9). Reddy and Katan (2007) also studied individual foods and food groups to compile sources that affect one's risk of hypertension. Some of the foods shown to decrease one's risk include fruits, berries, vegetables,

fiber, fish and fish oils, and potassium. Alternatively, some of the foods shown to increase one's risk are as follows: *trans* fatty acids, sodium, saturated fatty acids, and sugar (pp. 173-181). Perhaps unsurprisingly, many of these foods mirror those listed for heart disease and are supported by similar research by Houston (2014), who also found a negative association between blood pressure and magnesium, vitamin C, sesame, and garlic. Additionally, Bastola et al. (2020) demonstrated a positive association between blood selenium concentrations and hypertension.

Because these nutritional links factor into both the management and treatment of hypertension, they provide a promising alternative to prescription medication. With this in mind, one should find it illogical that many medical schools neglect clinical nutrition while pharmacology remains a staple subject for medical students, often demanding several courses across multiple years in students' curricula. This is not to argue that pharmacology is less important than clinical nutrition, but rather that the latter should warrant a similar amount of time in the curriculum as the former. Physicians seem to agree that patients benefit from a combination of nutritional and pharmacological therapies. According to multiple primary care physicians and ophthalmologists, nutrition often serves as the therapy of choice for chronic conditions like prehypertension, prediabetes, macular degeneration, and dry eye syndrome, according to multiple primary care physicians and ophthalmologists. But, when these conditions worsen, physicians note that they regularly turn to prescription medication (C. Reilly-Torres, personal communication, March 2, 2022; L. Platt, personal communication March 21, 2022; M. Clary, personal communication, March 23, 2022). Granted, more than scholarly literature and evidence from clinical trials influences decisions by medical school administrators about which subjects to include in their schools' curricula. Demands from patients nationwide, matriculating medical students, and decisions by other medical schools are only a few of the factors that affect

curricula (Dr. Alexa Gandy, personal communication, January 7, 2022), not to mention potential pressure from the pharmaceutical, food, and beverage industries. However, forces of this nature exist outside of the scope of this paper and will not be discussed comprehensively.

Diabetes

As another nutrition-related disease from which millions of Americans currently suffer, diabetes is often described simply as a health condition that affects how one's body converts food into energy using insulin. Multiple types of diabetes exist, with the most common being type 2 diabetes, which accounts for over 90% of the millions of Americans suffering from diabetes, according to the CDC (Dec. 2021). Most of the literature addressing diabetes tends to focus on type 2 as well. Unlike type 1 diabetics, type 2 diabetics produce sufficient or elevated levels of insulin but suffer from insulin resistance as their cells do not respond normally to the insulin their pancreases produce. Chronic high blood sugar is a risk factor for heart disease and diabetes and is commonly experienced in comorbidity with obesity and other nutrition-related diseases (CDC, Dec. 2021). Fortunately, healthcare providers, including physicians, agree that diabetes is largely a self-managed disease with well-documented success from lifestyle therapies that include proper nutrition, adequate exercise, stress management, and limited alcohol consumption.

In addition to regular, often daily, blood sugar readings, physicians monitor a patient's diabetes using the hemoglobin A1C diagnostic test, which measures one's average blood sugar over the last three months. Physicians also use this test to identify prediabetes and to diagnose diabetes, so researchers often measure therapy efficacy using subjects' A1C readings. For example, when assessing the efficacy of medical nutrition therapy (MNT) compared to available

medication for type 2 diabetes, Evert et al. (2019) compared improvements in participants' A1C. They found that A1C reductions from MNT, evident by decreased blood sugar levels and improving diabetes conditions, were similar to or greater than those expected from prescription medication (p. 732). The same research team compared various eating patterns, such as Mediterranean-style, vegetarian or vegan, and low-fat diets, by examining A1C changes, among other indicators, resulting from adherence to the diets (pp. 735-8). Similar results about MNT's effectiveness exist in other research from Evert et al. (2014), Morris & Wylie-Rosett (2010), and Pastors et al. (2002). These researchers have provided an abundant pool of clinical information that physicians can reference as they diagnose and treat their patients. However, like other clinical nutrition literature, the information presented contains a wide variety of nutrition opinions that often overlap and conflict with each other. And again, the argument could be made that the standardization of clinical nutrition education via integration into medical schools would likely benefit physicians and their patients as both learn to better prevent, manage, and treat diabetes in themselves and nationwide.

Many physicians nationwide recognize medical nutrition therapy as one of the most effective ways to combat diabetes. MNT, also referred to as clinical nutrition here and in the literature, retains an established role in modern American medicine, yet providers, administrators, and even patients, have choked its expansion and application to other diseases in favor of prescription medication or surgery. The healthcare industry could greatly benefit from expanding its use of MNT and by encouraging patients to self-manage more diseases beyond diabetes. More specifically, physicians should equip their patients with clear dietary advice that is as simple as possible and encourage them to adhere to that advice while catering to their individual preferences and habits. The literature offers several strategies to help make this

happen. According to Evert et al. (2019), diabetes therapy, which could be extrapolated to other nutrition-related diseases, should consist of personalized nutrition treatment, increased communication between physician and patient, and reduced barriers relating to MNT access, such as allowing self-referrals for it (p. 745). These, plus the return of clinical nutrition as a high priority subject in medical education, would help expand MNT into other diseases and fields, which, if given the chance to demonstrate (cost-)effectiveness, could influence third-party payers to cover it, which is often cited as a major impediment to the use of MNT (Evert et al., 2019, p. 745). Dr. Christina Reilly-Torres, a primary care physician in Columbia, SC, has practiced with nutrition in mind for over twenty years and is well aware of the barrier that insurance can pose to MNT. In that time, she has counseled patients in the Department of Defense, private practice, and, most recently, in the Veterans Affairs hospital in Columbia. Repeatedly, Dr. Torres explained to me that both physicians, including herself, and patients are more receptive to nutrition therapies when cost does not act as a deterrent. She explained that unlike her patients in private practice whose insurance companies usually did not cover it, her veterans do not pay out of pocket for MNT. While third-party coverage is not a major component of this paper, Dr. Torres's accounts still support the argument for increased clinical nutrition presence in medical education; she explained to me that many of her patients are able to improve their A1Cs and lower their blood pressures, both serving to decrease their risk for heart disease and several other diseases, through dietary changes alone (C. Reilly-Torres, personal communication, March 2, 2022).

Cancer

Second only to heart disease in number of fatalities, cancer is among the deadliest and perhaps the most feared diseases, killing hundreds of thousands of Americans every year (CDC, Oct. 2021). Over one hundred types of cancer exist, and among the most common, colorectal cancer (cancer of the colon and rectum) alone accounted for nearly 150,000 new cases and 53,000 deaths in America in 2021, according to the National Cancer Institute (2021). As many know, cancer is a multifaceted disease that me be caused by various factors, including diet, substance use, environmental exposure, and genetics, to name a few. While investigation into the factors contributing to the development of cancer continues, researchers have documented some interesting and telling relationships between cancer and nutrition.

The European Prospective Investigation into Cancer and Nutrition (EPIC) study has contributed much to the existing literature as researchers have assembled one of the largest cohorts of men and women with over 500,000 participants in ten European countries. The EPIC study continually adds to cancer research as its researchers follow its participants, often for several years. Much of the study's published work relates to colorectal cancer, both to specific food items and to broad body composition measurements. EPIC researchers have demonstrated a positive association between a high intake of red and processed meat and colorectal cancer, but an inverse association between fish and colorectal cancer (Norat et al., 2005). They have also shown a strong positive relationship between body weight, BMI, waist circumference, and abdominal fat accumulation and colorectal cancer, and even prostate cancer (Pischon et al., 2006; Pischon et al., 2008). Many of these relationships held for both men and women, but a few were stronger among some groups than for others. For example, Pischon et al. (2006) explained that

the relationship between cancer and body weight and BMI was much stronger in men than in women.

Some may attempt to dismiss these results as they were collected using European participants instead of Americans, but these results are indeed relevant as already-high rates of overweight and obesity continue to rise and Americans continue to eat millions of pounds of red and processed meats every year, often opting for beef and pork in place of fish. As a result, these relationships remain relevant for American physicians who are tasked with treating cancer. While more research on the topic is needed, we should be optimistic that diet and other lifestyle behavior changes may provide avenues for the prevention, management, and treatment of various cancers. Several of these potential therapies have already been documented in other EPIC studies. As noted above, fish consumption has been shown to decrease one's risk of colorectal cancer (Pischon et al., 2005). Additionally, an increase in dietary fiber seems to protect against colorectal cancer, according to the EPIC team of Bingham et al. (2003). Additional research in this area is necessary because the team studied fiber in foods, which could have other nutrients that fight cancer. For this particular study, foods like cereal, vegetables, fruits, and legumes were associated with decreased colorectal cancer risk. As research through clinical trials continues, physicians, especially oncologists, may learn about viable nutrition therapies and should remain receptive to these possibilities. This is not to say that physicians are close-minded, but rather to caution them against discounting these therapies due solely to their origins in nutrition, as many of their administrators and instructors have when they perpetuated the idea that nutrition should remain a low priority subject.

Obesity

Numerous other diseases beyond heart disease, hypertension, diabetes, and cancer stem from one's diet. Yet, some of these diseases, such as obesity, have proven more resilient than others against nutritional therapies. Alone, obesity is not America's most deadly disease, but it is one of the most visible. Over half of the U.S. population qualifies as overweight and obese—defined as having a Body Mass Index (BMI) equal to or greater than 25 and 30, respectively—and rates continue to rise. Common sense should tell us that what we eat, along with how much we eat, drives the increasing prevalence of obesity. Researchers date the beginning of the obesity epidemic in the 1970's and estimate that a positive energy imbalance of around 400 Calories per day has contributed to the steady rise in the rates of obesity. Perhaps unsurprisingly, they attribute this gap in energy to increased food intake and sedentary behavior. The same researchers argue that those with class III obesity, defined as having a BMI of greater than 40, represent "the fastest growing segment of the obese population" (Blackburn et al., 2010, p. 289S). For this group of Americans, bariatric surgery serves as the most effective therapy for weight loss. This poses a serious problem for containing the obesity epidemic as surgery is expensive, invasive, and laden with risks, making it virtually impossible to apply on a nationwide scale. So, researchers in the field of clinical nutrition advocate for the aggressive use of lifestyle interventions to combat rising obesity rates, especially among those suffering from class III obesity.

Researchers advise that these diet and exercise interventions should close the energy gap to sustain a long-term energy deficit while reducing the loss of fat-free mass. Appropriate nutrition and exercise therapies offer several advantages over bariatric surgery. For example,

primary care physicians would supervise these interventions instead of surgeons, which would reduce costs. Additionally, these therapies are applicable to the masses and pose fewer risks than invasive weight-loss surgeries (Blackburn et al., 2010).

While some researchers continue to advocate for behavioral lifestyle interventions, others argue that they are not always effective, as indicated by high rates of relapse (Mark, 2008, p. 1429). Several explanations for these high rates of relapse have been offered, such as the psychological explanation that contends that one's lack of willpower and self-discipline are to blame, instead of the physicians' ineffective therapies. However, recent research offers possible updates to the biological explanation, which suggests that hormones play a more significant role in the development, maintenance, and treatment of obesity than previously thought. The evidence indicates that numerous biological adaptations undermine patients' adherence to weight-loss therapies, such as calorie restriction. This explanation relies mainly on the appetite hormones, leptin and ghrelin. During a period of caloric restriction, leptin levels decrease and ghrelin levels increase. In both cases, one's appetite is stimulated, and the feeling of satiety is suppressed. Researchers have shown that manipulating the concentrations of these hormones can significantly affect appetite, behavior, and calorie intake. According to Mark (2008) and other researchers, "Children with congenital leptin deficiency have aggressive food-seeking behavior. Before leptin treatment, a young child with leptin deficiency consumed in excess of 1100 calories at a single meal…With only a few injections of leptin, this was reduced to 84%...the typical intake of a child" (p.1430). High concentrations of ghrelin similarly stimulate appetite and work to hinder adherence to caloric restriction therapies.

This research on the biological explanation, specifically the roles of the appetite hormones, implies that obesity could be treated not only by primary care physicians and bariatric surgeons, but by endocrinologists as well. Other researchers have proposed alternative theories about the causes of obesity, including the role of silent inflammation. In this theory, anti-inflammatory nutrition would target ingestible nutrients upstream of the production of arachidonic acid, a significant driver of inflammation in the body. To contrast, prescription medication typically works to inhibit arachidonic acid downstream after the body has produced it. Researchers hypothesize that effective obesity therapies should aim to reduce silent inflammation, thus producing consistent fat loss as a secondary result (Sears & Ricordi, 2011). Unfortunately, these theoretical pieces dominate the literature because both researchers and healthcare providers have failed to control American obesity through extensive practical applications. Fortunately, clinical nutrition researchers have historically proven themselves capable of formulating effective nutritional approaches, so we should remain optimistic that they will turn the tide in the battle against obesity in the near future.

Conclusion and Future Perspective

Although many American medical schools have not returned nutrition to a high priority subject, the outlook within the medical community is not totally grim. Still in the early stages in a few schools, a resurgence of interest in clinical nutrition has begun. Today, administrators often develop nutrition instruction within Lifestyle or Culinary Medicine programs. These programs teach students to approach a patient holistically, incorporating nutrition into broader behavioral changes, such as dietary and exercise habits or cooking techniques. The American College of Lifestyle Medicine defines Lifestyle Medicine as, "addressing the root causes of disease with evidence-based therapies in lifestyle behaviors such as diet, exercise, sleep, social connectivity and stress" (ACLM, 2022). Culinary Medicine differs from Lifestyle Medicine in that it teaches culinary techniques to medical students so that they can later do the same for their patients. While a minority of U.S. medical schools offer either one of these programs, even fewer offer both. A leader in the revival of nutrition education, the University of South Carolina School of Medicine Greenville has successfully included both programs in its curriculum. Administrators there have found success through integrating Lifestyle Medicine within the curricula and by offering various elective courses, including Culinary Medicine (Dr. Jennifer Trilk, personal communication, October 11, 2021).

Despite numerous recommendations, medical educators have shifted away from standalone nutrition courses, opting for integration into other courses instead. Fortunately, some have found success and are collaborating with others to reform medical education. Although not always together, the fields of medicine and nutrition have both developed substantially since Hippocrates' time. As I have shown, nutrition science bears much responsibility for our

understanding of metabolism due mainly to European work during the 18th and 19th centuries. The field continued to expand during the 19th and 20th centuries as nutrition became an integral component of the victory over the deficiency diseases. Unfortunately, the subsequent decrease in concern for deficiency diseases and better food technologies prompted American medical educators to fragment or integrate clinical nutrition education into other subjects. Today, deficiency diseases remain of little concern. Instead, chronic diseases are on the rise, killing millions of Americans every year. Researchers have shown that nutrition and other lifestyle indicators significantly affect one's likelihood of developing such diseases. Fortunately, nutrition and other behavioral changes have demonstrated an ability to treat, and often reverse, these chronic conditions. The medical needs of millions of Americans demand reform in medical education. American medical educators should return nutrition to a high priority subject, either by returning to standalone nutrition courses or weaving nutrition into Lifestyle and Culinary Medicine programs, as the USC School of Medicine Greenville has done. Although this reprioritization may come slowly, we should feel confident that these reforms, as in the early 20th century, will combine the great advances in knowledge of both nutrition and medicine to effectively address America's needs.

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