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Impacts of Diets and Food Plans in Health and Diseases—A Narrative Review

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ABSTRACT

The evolution of diet due to cultural, economic, and social factors has been an ongoing phenomenon that is heavily influenced by the rise of health issues, such as obesity, diabetes, and cardiovascular diseases. Despite enormous public attention, the importance of diet as a key determinant of health, physical fitness, and diseases such as non-communicable diseases (NCD) has remained underscored. This review emphasizes different diet types, providing insights into their nutritional content and health effects. Vegetarian and vegan diets, ketogenic diets, Mediterranean diets, Western diets, pescatarian diets, flexitarian diets, and territorial diversified diets are discussed, highlighting their influences on health, and diseases. A total of 191 peer-reviewed articles and reviews published between 2012 and 2025 have been analyzed to understand the role of various diets in preventing and dealing with the emerging global epidemic of NCDs. Significant heterogeneity have been observed in these study reports. As a result, we performed a narrative synthesis only. Nevertheless, the present review calls for ongoing research and a better understanding of factors contributing to the quality of diets and their impact on health outcomes. The identification of gaps and challenges within the current knowledge base is crucial for guiding future research directions in the ever-evolving area of dietary interventions.

1 | Introduction

Chronic degenerative diseases (CDDs), such as obesity, cardiovascular disease, diabetes, chronic kidney disease, inflammatory bowel diseases, osteoporosis, sarcopenia, neurodegenerative disease, rheumatoid arthritis, and many cancers, have been the most frequent causes of prolonged disabilities and deaths worldwide. About 17 million people die prematurely each year from CDDs, and patients with one or more CDDs represent over 30% of the population with 70%–80% of public health resources being spent on the management of CDDs (Di Renzo et al. 2019). According to the Global Burden of Disease, the major determinants of CDDs are mainly attributable to behavioral risk factors, such as poor nutrition, reduced fruit and vegetable intake, high body mass index (BMI) ($\geq$ 25.0 kg/m^2), cigarette smoking, high alcohol consumption, and low level of physical activity (Benziger et al. 2016). The main dietary contributing factors to deaths were (a) reduced consumption of fruit (4.9 million attributable deaths/year), of vegetables (1.8 million), of nuts and seeds (2.5 million), of whole grains (1.7 million); and (b) high sodium consumption (3.1 million) (Di Renzo et al. 2021).

Over time, many diets have evolved to serve as vital sources of critical nutrients. A diet is defined as the amounts of food and drinks consumed to maintain optimal health. Dietary interventions have thus emerged as promising adjunctive treatment strategies for cancer, neurodegenerative diseases, autoimmune

diseases, cardiovascular diseases, and metabolic disorders via the modulation of metabolism, disease trajectory, and therapeutic responses (Xiao et al. 2024; Janssen et al. 2021). Diet is intricately connected to cultural practices and local food availability as well, whereby a healthy diet provides all required nutrients essential for growth and development without exhibiting harmful effects (de Ridder et al. 2017).

A balanced diet, comprising of both plant-based and animal-based foods, is important for providing essential nutrients that contribute to overall health, energy, and the maintenance of bodily functions. This not only helps regulate body processes but also aids in the development and strengthening of muscles, bones, and tendons. A well-rounded diet plan encompasses a variety of foods, such as vegetables, fruits, whole grains, and low-fat dairy or fat-free options (Rakhra et al. 2020), though assessing the health impacts of diverse diets on the general population is a complex task requiring a comprehensive review of existing literature (Leggio et al. 2017).

Modern day lifestyles have significantly contributed to an increase in non-communicable diseases (NCDs) that are reported to have a connection with diets (Krishnaswamy et al. 2016; Hyseni et al. 2017; Sarwar et al. 2015). NCDs have impacted individuals, economies, and societies to a great extent (Kirwan et al. 2020). A lack of proper nutrient sources in daily diets has now been linked to many diseases, emphasizing the importance of treating diet as a form of medicine (Sarwar et al. 2015). NCDs, such as diabetes, obesity, cardiovascular diseases, various forms of cancer, persistent respiratory conditions, and cognitive impairments, continue to be a major contributor to disability and mortality (Di Renzo et al. 2021). According to the report by Cena and Calder (2020), a well-rounded and healthy diet encompasses the right proportions of macronutrients (protein, fat, and carbohydrates) necessary for daily functioning and cellular energy processes. Additionally, it includes micronutrients such as minerals and vitamins crucial in small quantities for overall body development and physiological functions. Ensuring adequate hydration is equally important, meeting the body's physiological requirements while supporting metabolism and energy without indulging in excess consumption beyond physiological needs.

Amidst a wealth of information, there exists confusion among medical professionals regarding what constitutes a healthy diet because every diet influences health and wellness differently (Kandel 2019). The definition of what constitutes a healthy diet is continually shifting to reflect the evolving understanding of the roles that different foods, essential nutrients, and other food components play in health and disease. A large and growing body of evidence supports that intake of certain types of nutrients, specific food groups, or overarching dietary patterns positively influences health and promotes the prevention of common NCDs (Cena and Calder 2020). Diet plays a critical role in preventing age-related diseases and preserving overall health during aging. Optimizing individuals' intrinsic capacity, including domains in cognition, psychological, sensory function, vitality, and locomotion, has been proposed as a model of healthy aging by the World Health Organization (Yeung et al. 2021). Three major dietary patterns, the Mediterranean diet, the Dietary Approaches to Stop Hypertension (DASH) diet, and the healthy plant-based diet have been reported to be the most effective and established dietary patterns in cardiovascular disease (CVD) prevention (Diab et al. 2023; Manolis et al. 2023).

The Mediterranean diet, listed as the intangible cultural heritage of humanity by UNESCO, is known as healthy and consumed worldwide (Santa et al. 2024). Substantial evidence from prospective cohort studies have shown that higher diet quality was associated with a 14%–29% lower risk of CVD and 0.5–2.2 years greater CVD-free survival time. In contrast, limited evidence was available from randomized controlled trials though evidence showed healthy dietary patterns improved risk factors for CVD and lower CVD risk (Petersen and Kris-Etherton 2021). The necessity for foods supplying vital nutrients and energy throughout various life stages requires the involvement of local resources and cultural practices to prevent nutrient deficiency diseases. Since the 1980s, dietary guidelines aimed at adverting chronic diseases have relied on epidemiological research to predict which dietary patterns correlate with reduced risk of chronic disease or links to health outcomes (Agostoni et al. 2024). “Food Is Medicine” (FIM) represents a spectrum of food-based interventions integrated into health care for patients with specific health conditions and often social needs. Evidence supports positive effects of FIM on food insecurity, diet quality, glucose control, hypertension, body weight, disease self-management, self-perceived physical and mental health, and cost-effectiveness or cost savings (Mozaffarian et al. 2024).

Promoting and sustaining optimal health and fitness, therefore, requires evidence-based decision guided by a combination of healthcare practices, individual behavior, structured interventions, and advancements in healthcare knowledge (Clemente-Suárez et al. 2023; Alosaimi et al. 2023; de Ridder et al. 2017). Finally, to address the confusion of role of diet in health and diseases, this current review highlights both the normal and vulnerable populations, providing the most recent and updated examination on the correlation between diet and health outcomes. Additionally, this review provides a comprehensive overview of the types of diets, evaluates the prevalence of diet-related diseases, gathers evidence regarding the health effects of various diets, examines the factors contributing to the quality of diets, and identifies gaps and challenges within the current knowledge base, and proposes directions for future research.

Meta-analysis was not conducted because much of the cited research in this review article had heterogeneity in terms of study design, population, interventions, and outcome measures. A combination of descriptive and narrative approaches produced a more reliable outcome related to the diets and food plans in health and diseases.

2 | Types of Diets

Different diet types such as the vegetarian, vegan, ketogenic, Mediterranean, Western, flexitarian, pescatarian, and territorial diversified diet types have been reported to influence health and wellness differently and are briefly reviewed below.

2.1 | Vegetarian Diet

Vegetarian and vegan diets are nutritionally sound and offer health benefits in specific areas of disease prevention and treatment. Essential nutrients are present in plant sources, though some nonessential nutrients such as saturated fats and cholesterol may be lower or absent in a vegetarian diet (Kahleova et al. 2018). A vegetarian diet typically includes dairy products, honey, and eggs. There are two main aspects: (a) lacto-ovo-vegetarianism (LOV) excludes meat but includes plant foods, eggs, and dairy, with subcategories such as ovo-vegetarianism (OV) and lacto-vegetarianism (LV) and (b) veganism (VEG) excludes dairy, meat, eggs, and honey but includes a variety of plant foods. This diet comprises vegetables, grains, nuts, seeds, legumes, and fruits, excluding all animal foods (Sebastiana et al. 2019).

Vegetarian diets are rich in antioxidants and fiber, offering protective mechanisms against heart disease and cancer. Additionally, vegetarian populations exhibit lower rates of hypertension, reduced risks of chronic diseases (such as type 2 diabetes and hypertension), and lower risks of certain cancers, including colon cancer (McEvoy et al. 2012; Gale 2020; Chauveau et al. 2019; Aran et al. 2016). Although vegetarian diets provide numerous health benefits, individuals need to ensure sufficient intake of certain nutrients typically found in animal products, such as protein, iron, and vitamin B12. Proper planning and supplementation are essential to maintain adequate nutrient levels for adult population consuming the vegetarian diet (Chauveau et al. 2019).

2.2 | Vegan Diet

A vegan diet excludes all animal products characterized by lower triglycerides and fasting blood glucose levels that may contribute to longevity and the prevention of chronic diseases (Białczyk et al. 2023). If a vegan diet is well-balanced and varied with the supplementation of calcium, iron, iodine, zinc, vitamin D, vitamin B12, ω-3 fatty acids, proteins, then it can help maintain a reliable state of health. To address the nutritional deficiencies associated with vegan diet, oral food supplements, especially fortified foods, are recommended (Marrone et al. 2021). Globally, cardiovascular diseases (CVD) are the leading cause of mortality, accounting for 20.5 million deaths in 2021, comprising approximately one-third of all global deaths (Di Cesare et al. 2024) or 46% of NCD related deaths (Kahleova et al. 2018). Plant based diets appear to be the only dietary pattern to have shown a reversal of chronic heart diseases, and evidence suggests the benefits of plant-based diets in both the prevention of cerebrovascular diseases and heart failure (Kahleova et al. 2018).

2.3 | Ketogenic Diet (KD)

The ketogenic or keto diet (KD) is a dietary approach characterized by high-fat and low-carbohydrate intake, aiming to facilitate weight loss, enhance mental clarity, and boost energy levels. By significantly reducing carbohydrate consumption and increasing fat and protein intake, this diet induces a metabolic state called ketosis, where the body utilizes fat as its primary fuel source instead of carbohydrates. The primary goal of the KD is to decrease overall body fat and improve metabolic health. Recent research indicates potential benefits in reducing the risk of certain diseases, including type 2 diabetes, hyperlipidemia, heart disease, and cancer (Masood et al. 2023).

KD elevates serum ketone bodies (KBs) levels, providing an alternative fuel source for the brain and other organs. However, KBs play pleiotropic roles that go beyond their role in energy production. KBs can act as signaling metabolites, influence gene expression, proteins' posttranslational modifications, inflammation, and oxidative stress (Giuliani and Longo 2024). The KD has been reported to manage neurodegenerative disorders (Alharbi and Al-Sowayan 2020).

The KD enhances glucose and lipid metabolism, reducing triglycerides and total cholesterol while increasing high-density lipoprotein levels and alleviating dyslipidemia. It significantly influences adipose tissue hormones, which are the key contributors to systemic metabolism. Ketone oxidation depletes intermediates in the Krebs cycle, requiring glucose, glycogen, or amino acids, for metabolic efficiency. The KD stimulates fibroblast growth factor 21, influencing metabolic stability via the Uncoupling protein 1 pathways. KD induces a reduction in muscle mass, potentially involving anti-lipolytic effects and attenuating proteolysis in skeletal muscles. Additionally, the KD contributes to neuroprotection, possesses anti-inflammatory properties, and alters epigenetics (Ahmad et al. 2024).

A recent review indicated that the KD was effective in promoting weight loss and reducing in serum hemoglobin A1c in patients with diabetes mellitus type 2 (O'Neill and Raggi 2020). According to another review, the KD has become very popular lately and was the most Googled diet with 25.4 million unique searches in the United States in 2020. As a result, the "keto" food industry was valued at $9.57 billion in 2019 (McGaugh and Barthel 2022). Moreover, the KD was shown to have a multifaceted effect on the prevention and treatment of CVD, that included a beneficial effect on the blood lipid profile, function of the vascular endothelium, inhibition of premature aging, and strong anti-inflammatory and cardioprotective potential (Dyńka et al. 2023).

Despite the reported beneficial outcome of PD, a few studies have raised concern over the adverse effects of KD on kidney health (Ayele et al. 2023) and on gut microbiota (Lindefeldt et al. 2019). The renal perturbations by KD included potential alterations on acid–base and electrolyte balance and risk for kidney stones (Ayele et al. 2023; Ko et al. 2020). The effects of KD on kidney function during normal and altered renal physiological conditions have been reviewed recently that warranted further studies to elucidate the mechanism of KD related kidney burden (Athinarayanan et al. 2024).

A more recent study has reported some adverse effects that include nausea, emesis, reduced appetite, hypoglycaemia, acidosis, increased risk of kidney stones, altered liver biochemistry, and skin rash (Skartun et al. 2025). Earlier studies reported that KD may cause hyperlipidemia, vitamin and

mineral deficiencies, fatigue, kidney damage (Joshi et al. 2019), and nephrolithiasis among the children with epilepsy (Juraschek et al. 2013).

Whether the higher protein mass relative to carbohydrate in KD is responsible for its adverse effect on the kidney is yet to be established. The breakdown of macronutrients in KD is typically 60% fat, 35% protein, and 10% carbohydrates. One of the largest human trials showed that a high protein diet increased estimated glomerular filtration (eGFR) by 3.8 mL/min after 6 weeks compared with a lower protein diet (Kalantar-Zadeh et al. 2020). This leads to hyperfiltration and proteinuria in the early stages but eventually results in loss of kidney function. A diet high in protein can cause intraglomerular hypertension, leading to glomerular hyperfiltration, injury, and proteinuria (Cirillo et al. 2014). Furthermore, in a population study of 1522 individuals aged 45 to 64 in Gubbio, it was found that those who consumed more protein had a lower eGFR after 12 years, regardless of whether they had chronic kidney disease (CKD) or not (Haring et al. 2017). The findings of Haring et al. (2017) reflected the results of earlier studies in which a long-term observational study of 1800 Iranian participants followed over 6 years showed that a high protein diet also had a high risk of CKD (Freeman et al. 1998).

Additionally, an alteration in gut microbial composition and functions by KD has been reported in a previous study (Lindefeldt et al. 2019). In this study, fecal samples were analyzed from 12 children with therapy-resistant epilepsy before starting KD and after 3 months on the diet. The result indicated that alpha diversity was not changed though differences in both taxonomic and functional composition were detected. Relative abundance of bifidobacteria as well as E. rectale and Dialister were significantly diminished during the intervention. An increase in the relative abundance of *Escherichia coli* was observed due to KD. As the relative abundance of health-promoting, fiber-consuming bacteria diminished during KD, a concern was raised in this study about the effects of KD on the gut microbiota and overall health.

Another recent study has evaluated the effects of a 6-week KD on biochemical parameters, gut microbial composition, and fecal short-chain fatty acids (SCFAs) in women with overweight/obesity. This study found significant changes in microbial composition, leading to dysbiosis and long-term adverse outcomes with changes in serum zonulin and fecal SCFA levels (Güzey Akansel et al. 2024). Yet, another review has indicated that, on a long-term basis, KD has the potential to induce dysbiosis and other complications. As a result, KD's risks and benefits need to be evaluated before using as a nutritional therapy (Santangelo et al. 2023).

2.4 | The Mediterranean Diet

The Mediterranean diet is currently regarded as one of the healthiest dietary models in the world (Gonçalves et al. 2024). This diet type reflects the typical food consumption styles of nations bordering the Mediterranean Sea, along with Greece, Italy, and Spain and is characterized by a high intake of culmination, greens, entire grains, legumes, nuts and seeds, a mild intake of seafood, fowl, eggs, dairy products, and a low consumption of beef and processed meals. Olive oil serves as the primary source of fat in this diet with wine during meals (Martínez-González 2024; Mensah et al. 2025; Dobroslavska et al. 2024).

2.5 | Western Diet

Western diets are characterized by high intake of processed animal-based foods, refined carbohydrates, saturated fats, salt, and desserts with a lower intake of vegetables, fresh fruit, and reduced-fat dairy products (Clemente-Suárez et al. 2023; Joshi et al. 2023). This diet has been linked to metabolic disorders, including acidosis, obesity, hypertension, diabetes, CVD, and other associated conditions, including cognitive impairment, emotional disorders, and ulcerative colitis (UC) (Adolph and Tilg 2024; García-Montero et al. 2021). The human gut ecosystem consists of almost 2000 different species of bacteria, forming a bioreactor fueled by dietary micronutrients to produce bioactive compounds that are absorbed by the body and signal to distant organs. Studies have shown that the Western diet, with fewer short-chain fatty acids, can alter the gut microbiome composition and cause the host's epigenetic reprogramming. UC is an autoimmune disease in which the immune system attacks the colon, leading to ulcer development, loss of colon function, and bloody diarrhea. Overproduction of H_2S from the gut microbiome due to food can further activate pro-inflammatory signaling pathways in UC (Majumder and Bano 2024). Western diets produce high dietary acid load (DAL). DAL leads to increased morbidity and mortality. Nutritional advice focusing on DAL, rather than macronutrients, is gaining rapid attention as it provides a more holistic approach to managing health (Wieërs et al. 2024).

2.6 | Pescatarian Diet

The pescatarian diet incorporates fish and seafood alongside plant-based foods as its primary sources of protein. A healthful plant-based foods are generally classified as vegan, lacto-vegetarian, lacto-ovo-vegetarian, or pescatarian diet. Similar to other vegetarian diets, pescatarian diets emphasize a plant-based approach, rich in fruits, vegetables, whole grains, nuts, and healthy fats, while excluding meat and poultry. This dietary choice is notable for being high in phytochemicals and omega-3 fatty acids, offering numerous health benefits. These advantages include a reduced risk of heart disease and stroke, lower likelihood of obesity, and decreased risk of overall and colorectal cancer (Parra-Soto et al. 2022). Moreover, adopting a pescatarian diet has been reported to protect against dyslipidemias, insulin resistance, hypertension, and low-grade inflammation (Thomas et al. 2023).

2.7 | Flexitarian and Territorial Diversified Diets

Flexitarian refers to a blend of “flexible” and “vegetarian,” diet where an individual follows a primarily vegetarian diet with

occasional intake of meat. A flexitarian or semi-vegetarian diet, therefore, predominantly consists of plant-based components such as fruits, vegetables, whole grains, legumes, soy products, nuts, and seeds. Flexitarian diets are generally adopted by those who appreciate meat on and off reflecting a balanced and flexible approach to dietary choices (Malek and Umberger 2021). There was emerging evidence suggestive of benefits of flexitarian diet for body weight, improved markers of metabolic health, blood pressure, and reduced risk of type 2 diabetes. Additionally, this diet has also shown to play a possible role in the treatment of inflammatory bowel diseases (Derbyshire 2017). A recent review reported that the flexitarian diet with reduced meat and processed meat products intake may contribute to CVD risk factor advantages (Bruns et al. 2024).

Territorial diversified diets (TDD) are formulated in the line of flexitarian approach, emphasizing high consumption of locally sourced and seasonal foods. Both flexitarian and territorial diversified diets are characterized by rich plant-based components and moderate amounts of fish, poultry, dairy, as well as limited intake of highly processed foods, added sugars, and red meat.

3 | Diet and Food Plans During Health and Diseases

Various food and diet plans are employed to manage cardiovascular health, obesity, type 2 diabetes, cancer, and in the management of gut microbiome (Wilson et al. 2020). It is essential to comprehend the impact of different diets on different health issues so that informed and thoughtful dietary choices can be made (Luconi et al. 2024).

3.1 | Cardiovascular Health

A wide variety of food plans are available to prevent, control, or maintain health during cardiovascular diseases (CVD). A variety of conditions affecting the heart and blood vessels are referred to as CVD, including hypertension, strokes, atherosclerosis, peripheral artery disease, and vein diseases (Clemente-Suárez et al. 2023). Food plans reported to be effective against CVD includes.

3.1.1 | Mediterranean Diet

This plan emphasizes the consumption of fruits, green vegetables, fruits, entire grains, legumes, nuts, seeds, fish, and olive oil whilst restricting the intake of pork, processed meals, and added sugars. This dietary plan has been reported to correlate with a reduced risk of CVD (Bays et al. 2022). When fortified with monounsaturated fats, omega-3 fatty acids, dietary fiber, antioxidants, and polyphenols, the Mediterranean weight loss plan contributes to improved heart health. Research studies indicate that adhering to the Mediterranean diet is linked to a lower incidence of heart disease, decreased levels of LDL (bad) cholesterol, lower blood pressure, and improved endothelial function (Pledger 2018).

3.1.2 | Dietary Approaches to Stop Hypertension (DASH) Plan

This plan emphasizes the consumption of fruits, vegetables, whole grains, lean proteins, and low-fat dairy products while minimizing the intake of saturated fats, cholesterol, and sodium to better control CVD such as atherosclerosis (Lu et al. 2024). Research studies have shown that the DASH plan effectively lowers blood pressure and reduces the risk of developing hypertension—a major risk factor for CVD (Brown et al. 2024).

3.1.3 | Plant-Based Diet Plans

These plans employ vegetarian and vegan diets and avoid or reduce the intake of animal products to manage CVD (Landry et al. 2024; Nacarelli et al. 2024). These diets typically include high levels of fiber, antioxidants, and phytochemicals, contributing to cardiovascular benefits (Yahia et al. 2019).

3.1.4 | Low-Carbohydrate Diets

Low-carbohydrate diets limit the intake of carbohydrates while promoting higher consumption of protein and fat (Giugliano et al. 2018). Although the impact of low-carbohydrate diets on CVD is not established, some studies suggest that these diets may lead to short-term improvements in blood triglyceride levels, HDL (good) cholesterol, and glycemic control. However, long-term adherence to very low-carbohydrate diets may have adverse effects on cardiovascular health due to potential nutrient deficiencies and increased consumption of saturated fats (Choi et al. 2020).

3.1.5 | Overall Impact of Various Diet Plans on CVD

CVD may refer to coronary artery, coronary heart, cerebrovascular, and peripheral artery diseases. Two important markers in assessing CVD risk are apolipoprotein (apo) B and apolipoprotein A1 plasma levels. These markers are measured as a ratio, with a high apoB to apoA1 ratio associated with increased CVD risk. A recent review has indicated that dietary and lifestyle recommendations are the cornerstone of managing primary and secondary CVD risk-mitigation strategies (Nacarelli et al. 2024).

A Western diet characterized by a high intake of energy-dense and processed food has been reported to be a risk factor for diabetes, obesity and CVD. One of the underlying mechanisms linking Western diet to these diseases is indicated to be mediated by inflammation. The Western diet has a high content of saturated fats, trans fats, sodium, and added sugars and low intake of fiber, fruits, and vegetables (Shi 2019). This diet has also been reported to increase the risk of cardiovascular issues via several additional mediators besides the inflammation (Clemente-Suárez et al. 2023). In contrast, consistent research supports the cardiovascular benefits of the Mediterranean diet. A recent review has documented that randomized trial studies have shown reduction in CVD with the Mediterranean diet (Feingold 2024). An earlier review reported that the

Mediterranean diet has been shown to reduce the burden, or even prevent the development, of cardiovascular disease, breast cancer, depression, colorectal cancer, diabetes, obesity, asthma, erectile dysfunction, and cognitive decline. In addition, this diet is also known to improve surrogates of cardiovascular disease, such as waist-to-hip ratio, lipids, and markers of inflammation, as well as primary cardiovascular disease outcomes such as death and events in both observational and randomized controlled trial data (Widmer et al. 2015).

Another recent review corroborated well with the earlier findings indicating that the Mediterranean diet serves as an effective intervention for both primary and secondary prevention of CVD, demonstrating a substantial and long-term impact in reducing the incidence of major adverse cardiovascular events, myocardial infarction, stroke, and cardiovascular-related mortality (Sebastian et al. 2024). In addition, the Mediterranean diet has shown to have an improved health performance during colon cancers (Donovan et al. 2017), a reduction in the burden of dementia (Nucci et al. 2024), improved sleep quality (Godos et al. 2024), and favorable preventive effects against obesity and diabetes (Pavlidou et al. 2023).

Evidence from observational and interventional studies have also demonstrated the benefits of plant-based diets in treating type 2 diabetes and reducing key diabetes-related macrovascular and microvascular complications (McMacken and Shah 2017). Another study published in the Journal of the American College of Cardiology reported that people following a plant-based diet have shown protective effects on weight gain, lipid profile, glycemic control, and blood pressure (Satija et al. 2017). Based on epidemiological data, one review has reported that CVD, cancer, hypertension, hyperlipidemia, diabetes mellitus, obesity, smoking, and diet are interrelated in determining overall health (Wilcox et al. 2024).

The effects of low-carbohydrate diets on cardiovascular health are a topic of continued discussion. Diets with a moderate carbohydrate content were associated with the lowest risk of all-cause and CVD mortality. When the sources of macronutrients that replaced carbohydrates were plant-based, the risk of all-cause mortality was reduced linearly with lower carbohydrate content. Similarly, the risk of cancer mortality increased linearly with the increase in carbohydrate content (Ghorbani et al. 2023). However, concerns exist about the long-term effects of very low-carbohydrate diets, as they often lead to increased consumption of saturated fats, which may negatively impact cardiovascular health (Macedo et al. 2020). Despite the reported reviews, extensive research studies have documented the efficacy of the low carbohydrate diet to improve the most robust CVD risk factors, such as hyperglycemia, hypertension, and atherogenic dyslipidemia (Diamond et al. 2022).

Thus, it has been well documented that a poor diet is a leading cause of obesity and type 2 diabetes mellitus leading to CVD related morbidity and mortality. As a result, dietary modification remains a cornerstone of CVD prevention, though implementation in clinical practice is limited by inadequate formal training in nutrition science (Pallazola et al. 2019). Pallazola et al., further emphasizes that CVD vulnerable patients should focus on implementing a general diet plan that is high in fruits, whole grains, legumes, and nonstarchy vegetables while low in *trans*-fats, saturated fats, sodium, red meat, refined carbohydrates, and sugar-sweetened beverages. According to them, The DASH, Mediterranean, and vegetarian diets have the most evidence for CVD prevention. It is, therefore, crucial to seek advice from healthcare professionals or registered dietitians for personalized dietary recommendations and to consider overall lifestyle factors when making dietary choices for CVD (Sikand and Severson 2020).

3.2 | Obesity

Obesity reflects an excess mass of body fat that may result from a sustained positive energy balance with resetting the body's "set point weight" at a higher value. An elevated body mass index that is determined from body weight as a function of body height is the most widely accepted definition of obesity, in which diet plays a significant role (Schwartz et al. 2017). Despite continuous advances in the medical world, obesity has remained a major worldwide health hazard, contributing to adult mortality as high as 2.8 million per year. This pervasive issue is closely linked to the development of chronic diseases that are predominantly associated with an unhealthy lifestyle and poor dietary habits (Masood et al. 2023). Obesity is identified as the most important and significant risk factor in the development of type 2 diabetes mellitus in all age groups. It has reached pandemic dimensions, making the treatment of obesity crucial in the prevention and management of type 2 diabetes worldwide. Multiple clinical studies have demonstrated that moderate and sustained weight loss can improve blood glucose levels, insulin action and reduce the need for diabetic medications. A combined approach of diet, exercise, and lifestyle modifications can successfully reduce obesity and subsequently ameliorate the ill effects and deadly complications of diabetes mellitus (Chandrasekaran and Weiskirchen 2024).

Similarly, childhood obesity has become a global concern that appears to be a consequence of the interaction between genetics and lifestyle (Nogueira-de-Almeida et al. 2024). The prevalence of childhood obesity and its associated comorbidities disproportionately affects populations in low- and middle-income countries and minority ethnicities in high-income countries (Alkhatib and Obita 2024). Over 100 million children and 600 million adults are estimated to be living with obesity currently, which is associated with cardiovascular disease, hypertension, type 2 diabetes mellitus, certain cancers, hyperlipidemia, sleep apnea, osteoarthritis, liver and gall bladder disease, and gynecological problems. Therefore, clinical practice guidelines have been developed in many jurisdictions to support the management of obesity (Gaskin et al. 2024).

Calorie density, water content, protein source, and other components significantly influence the effectiveness of different dietary regimes for weight loss, so that whole foods sourced from plants may be the optimal option in obesity control (Greger 2020).

Because obesity has become a major health concern (Larruy-García et al. 2024; Reger et al. 2024; Han et al. 2024), recent reviews on dietary plans to control obesity are included below.

3.2.1 | Low-Calorie Diets

Typically, low-calorie diets involve portion control and a focus on consuming nutrient-dense, low-calorie meals (Smethers and Rolls 2018; Dobbie et al. 2024). When followed correctly, low-calorie diets can lead to weight loss by creating an energy imbalance (Peters and Beck 2016).

3.2.2 | Low-Carbohydrate Diets

Low-carbohydrate diets limit the intake of carbohydrates while promoting higher intakes of protein and fat. These diets often result in initial rapid weight loss due to the depletion of glycogen stores and the associated loss of water from the body. However, the long-term effects of low-carbohydrate diets on weight control are still under debate, and adherence to these diets may vary among individuals (Churuangsuk et al. 2020). By reducing insulin levels and increasing satiety, low-carb diets may contribute to a decrease in overall calorie consumption leading to better obesity control. These reviewers noted that the international guidelines recognize the validity and endorse the use of low carbohydrate diets as a therapeutic nutritional approach, in appropriate patients (Kelly et al. 2020). A recently reported meta-analysis has inferred that a low-carbohydrate diet appears to be among the most effective approaches for weight loss and body fat reduction in which the efficacy of diet may vary based on age, gender, genetics, and lifestyle habits (Akbari et al. 2024).

3.2.3 | High-Protein Diets

High-protein diets prioritize the consumption of foods rich in protein, which can promote feelings of fullness and increase the thermic effect of food, potentially leading to increased calorie burning.

Long-term clinical trials of 6–12 months have reported that a high-protein diet provides weight-loss effects and can prevent weight regain after weight loss. High-protein diet induced weight-loss was mediated by a multitude of factors including elevated diet-induced thermogenesis, increased satiety signaling, and reduced food intake (Moon and Koh 2020). Similar findings have been reported in a more recent review substantiating that a higher dietary protein intake for less than 6 months may facilitate weight loss in obesity. This review highlights that the source of protein plays a crucial role in which animal-based, but not plant-based, protein intake may have adverse effects in relation to the development of obesity during a long-term consumption process. Accordingly, a relatively increased intake of plant protein should be considered in relation to the use of high-protein diets to control obesity (Anjom-Shoae et al. 2024). Similar conclusions that the quality of protein sources is important to control obesity have also been made in earlier reviews (Caprio et al. 2019).

3.2.4 | Balanced Macronutrient Diets

A balanced macronutrient diet prioritizes a well-rounded consumption of carbohydrates, proteins, and fats, providing a moderate and sustainable approach to weight management (Smethers and Rolls 2018). These diets often focus on the reduction or increase of selected macronutrients such as fat and carbohydrates that still contain a variety of essential nutrients for overall health (Fleming and Kris-Etherton 2016). By encouraging a balanced energy intake and ensuring nutrient adequacy, balanced macronutrient diets can contribute to maintaining a healthy weight (Chao et al. 2021).

3.2.5 | Meal Substituted Diets

Meal replacement diets involving the substitution of one or more daily meals with low-calorie diets and very-low-calorie diets is considered a part of the medical nutrition therapy toolbox. As per this approach, meal replacements generally utilize distinct, fixed-energy, portion-controlled food products or drinks (often fortified with essential vitamins and minerals) that are consumed in place of traditional foods to reduce energy intake. Meal replacements can be products specifically marketed for weight loss, such as protein shakes or bars, or can be portion-controlled conventional/frozen foods. Meal replacement interventions are often a key component of a low-calorie diet that replaces a minimum of two meals per day in conjunction with one balanced, energy-limited, nutritious meal with an overall prescribed energy intake of 1000–1200 kcal/day (Edwards-Hampton and Ard 2024). As a result, these diets facilitate portion control and calorie restriction, leading to weight loss (Min et al. 2021). They are convenient for individuals seeking structure and convenience in their dietary choices (S. Y. Kim et al. 2022). A review study has demonstrated that programs incorporating meal replacements led to greater weight loss at 1 year than comparative weight loss programs, thus suggesting meal replacement as a valid option for management of overweight and obesity in community and health care settings (Astbury et al. 2019).

3.2.6 | Overall Impact of Various Diet Plans on Obesity

Research on the impact of different diets on weight management has produced varied outcomes depending on the population groups. Some studies suggest that low-calorie diets, especially when combined with behavior modification and physical activity, can result in significant weight loss over an extended period. For elderly with obesity, it is advisable to maintain a minimum intake of 1000–1200 kcal/day to achieve a weight loss of 0.25–1 kg/week that corresponds to approximately 5%–10% loss of the initial body weight after a period of 6 months or longer. Simultaneously, a protein intake of at least 1 g per kilogram of body weight per day, adequate intake of essential micronutrients, and avoiding very low-calorie diets is

necessary to prevent malnutrition and a decline in physical function (Battista et al. 2024). Observational studies have demonstrated positive associations between ultra-processed food intake, weight gain, and overweight/obesity more clearly in adults than in children and adolescents (Dicken and Batterham 2024).

Gender has been reported to be an important variable in obesity analysis as the gender differences exist in obesity prevalence and phenotype, body fat distribution, drug efficacy, clinical trial representation, and different secondary effects of bariatric surgery (Muscogiuri et al. 2024). It's worth noting that individual factors such as genetics, metabolic rate, lifestyle, physical activity, exercise, and adherence play significant roles in the success of any weight management strategy (Swift et al. 2018). In general, a low-carbohydrate diet has demonstrated significant potential for weight loss and weight management (Volek et al. 2021), though it is essential to choose an approach that aligns with individual preferences, health goals, and lifestyle (Killingback et al. 2017). Additionally, incorporating regular physical activities, practicing mindful eating, and seeking support from healthcare professionals or registered dietitians can further enhance the effectiveness and sustainability of weight management efforts (Panão and Carraça 2020).

3.3 | Diabetes

Nutrition therapy has been emphasized for decades for people with type 2 diabetes, and the vital importance of diet and nutrition is now also recognized for Type 2 diabetes mellitus (T2DM) prevention (Forouhi 2023). A recent review has demonstrated that different diets can prevent or slow down the development of non-communicable diseases including obesity, T2DM, cardiovascular diseases, and low-grade inflammation (Fričová et al. 2024). The impacts of various diet plans on diabetes are included below.

3.3.1 | Mediterranean Diet Plan

The Mediterranean diet is one of the most studied and successful dietary plans in managing and preventing T2DM. This diet is abundant in fruits, vegetables, whole grains, legumes, nuts, seeds, olive oil, aromatic herbs and spices, and has been linked to a better control of T2DM (Garza et al. 2024). Studies indicate that following the Mediterranean diet is associated with improved glycemic control and other markers of T2DM and CVD (Astbury 2024). The Mediterranean diet has thus gained recognition as one of the healthiest patterns of living for its cardiovascular, metabolic, cognitive, and possibly antineoplastic benefits. The diet is advised today by a large majority of medical professionals all over the world (Lăcătuşu et al. 2019). Current evidence suggests that high-quality dietary patterns such as the Dietary Approaches to Stop Hypertension (DASH) eating plan and the Mediterranean diet is important in the metabolic control processes of T2DM with anti-inflammatory and antioxidant compounds, Glucagon-like-peptide agonist compounds, and intestinal microbiota changes (Dal and Bilici 2024).

3.3.2 | Low-Carbohydrate Diet

There are several dietary schemes available, such as low-fat, low-carbohydrate, Mediterranean-style diets that can improve glycemic control and insulin responses. Decreasing the carbohydrates in meals also improves glycemic control and insulin responses, but the extent of this reduction should be individualized, patient-centered, and monitored (Papakonstantinou et al. 2022). Low-carbohydrate diets, defined by limited carbohydrate intake and higher proportions of proteins and fats, have demonstrated weight and HbA1c-lowering effects in many clinical trials. A service evaluation of a primary care practice in England that adopted an LCD approach showed that 46% of people with T2DM induced remission, accompanied with significant improvements in the lipid profile, blood pressure, and a decrease in bodyweight (Aksoy et al. 2024). A recent review has indicated that low-carbohydrate and energy-restricted diets effectively manage T2DM, improving lipid profiles, body weight, waist circumference, HbA1c, and blood pressure and reducing medication reliance (Arias-Marroquín et al. 2024).

3.3.3 | Low-Glycemic Index Food Plan

The low-glycemic index (GI) diet focuses on consuming foods that have a minimal impact on blood sugar levels. These diets emphasize complex carbohydrates with a lower GI, such as whole grains, legumes, and non-starchy vegetables, while limiting refined carbohydrates and sugary foods. By choosing foods that promote a slower and steadier rise in blood sugar levels, the low-GI diet helps regulate blood glucose and insulin responses, making it beneficial for individuals with type 2 diabetes. For glycemic control in T2DM patients, the ketogenic diet, Mediterranean diet, moderate-carbohydrate diet, and low glycemic index diet were effective options (Jing et al. 2023). One recent review has concluded that adopting a low-GI diet may help minimize fluctuations in blood glucose levels. This dietary pattern may improve glycemic control and reduce the inflammatory response in people with T2DM. However, the independent effect of low-GI diets on whole-body insulin sensitivity is still unclear (Gerontiti et al. 2024). Low-GI foods and diet. also have shown benefits in terms of short-term glycemic control, weight, and adiposity as revealed from 14 different randomized controlled trial studies with 1055 participants where low GI diet was followed for 1–36 months. This review further reported positive effects of low-GI interventions on blood pressure, inflammatory biomarkers, renal function, and gut microbiota composition (Peres et al. 2023). In a randomized controlled trial (RCT) study, the portfolio diet has been found to lower HbA1c over a 6-month period. This is a dietary pattern with cholesterol-lowering foods that is also rich in low GI foods (Kavanagh et al. 2024).

3.3.4 | Plant-Based Diets

Plant-based diets include those with an emphasis on plant foods, such as vegetarian, vegan, Mediterranean or combination diets. Plant-based diets, along with healthy habits, have emerged as a relevant strategy in obesity and T2DM prevention (Silva

et al. 2024). Plant-based foods represent a promising natural approach for the management of T2DM due to the vast array of phytochemicals they contain. Numerous epidemiological studies have highlighted the importance of a diet rich in plant-based foods (vegetables, fruits, spices, and condiments) in the prevention and management of DM. Unlike conventional medications, such natural products are widely accessible, affordable, and generally free from adverse effects. Integrating plant-derived foods into the daily diet not only helps control the hyperglycemia observed in DM but also supports weight management in obese individuals and has broad health benefits (Ansari et al. 2024). Evidence from meta-analyses of epidemiological studies have indicated that those following plant-based dietary regimes have around 20%–25% lower risk of developing CVD and a similar reduced risk of developing T2D. Further evidence from RCTs have indicated that those following plant-based dietary regimes have lower total cholesterol, low-density lipoprotein-cholesterol and blood pressure, and modest reductions in inflammatory and endothelial markers. Higher intake of plant foods has been associated with lower incidence of obesity, lower BMI and smaller waist circumference (Harland and Garton 2016). Vegetarian dietary patterns have also been associated with meaningful improvements in glycemic control by reducing HbA1c (Guest et al. 2024).

3.3.5 | Overall Impact of Various Diet Plans on Diabetes

Diet and T2DM are connected in many respects. One example is the involvement of glucagon-like peptide 1 (GLP-1), a gastrointestinal peptide and central mediator of glucose metabolism that is secreted by L cells in the intestine in response to food intake. Physiologically stimulated GLP-1 secretion through diet has, therefore, been recommended as a preventive or synergistic method for improving glucose metabolism in T2DM (Huber et al. 2024). Accordingly, various diet plans have been reported to exert a positive impact on the prevention and control of type 2 diabetes. A recent review using UK Biobank data has found that high adherence to "healthy" dietary patterns that include various food types, with at least three servings/day of whole grain, fruits, and vegetables, and meat and processed meat less than twice a week slightly lowers the risk of T2DM, CVD, and colorectal cancer (Navratilova et al. 2024). A growing body of evidence has also indicated that the timing and frequency of meals have been associated with obesity, T2DM, cardiovascular disease, and other chronic conditions (Verde et al. 2024).

On the other hand, the vital role of gut microbiota in T2DM has gained attention only recently. It has been demonstrated that the gut microbiota functions like an endocrine organ, influencing which nutrients are metabolized and absorbed. Therefore, the composition of the gut microbiota plays a central role in T2DM pathogenesis, interacting with genetic predisposition, diet, lifestyle factors, and stress to create individual disease profiles (Baars et al. 2024). Precision and personalized nutrition are emerging fields of study in T2DM. Genomic studies have allowed the characterization of sequence DNA variants across the human genome, some of which may affect gene expression and protein functions relevant for glucose homeostasis. Novel genotype-based dietary strategies have been developed that offer opportunities to personalize the screening, prevention, diagnosis, management, and prognosis of T2DM through precision nutrition (Ramos-Lopez 2024).

3.4 | Cancer

The role of dietary interventions and the pathogenesis of cancer is complex. Moreover, the mechanisms underlying the diet-based therapeutic strategies remain unexplored. Dietary guidelines are normally formulated to enhance the health of society, reduce the risk of NCD, and prevent nutritional deficiencies. Diet and exercise are modifiable lifestyle factors known to have a major influence on metabolism. Clinical practice addresses diabetes or hypertension by altering these factors. Despite enormous public interest, there are limited defined diet and exercise regimens for cancer patients (Locasale et al. 2024).

Metabolic reprogramming is a hallmark of cancer progression, and a deeper understanding of altered metabolism during tumors and its effects on immune regulation is essential to control malignant processes. Emerging evidence have indicated that dietary interventions might affect the nutrient availability in tumors, thereby increasing the efficacy of cancer treatments (Xiao et al. 2024). A plant-based diet has recently been reported to contain fewer amino acids than an animal-based diet and is effective in cancer management. It is known that amino acids are critical to tumor survival. Tumors can acquire amino acids from the surrounding microenvironment, including serum. Limiting dietary amino acids is suggested to influence their serum levels. However, the extent to which a plant-based diet lowers the serum levels of amino acids in patients with cancer is yet to be understood (Scales et al. 2024). A diet rich in micronutrients found in vegetables, fruits, fish and animal products have been shown to possess antioxidant, anti-inflammatory, antiangiogenic, and antiproliferative properties that have a preventive role in the development of oral and other types of cancers (Rodríguez-Molinero et al. 2021).

The American Cancer Society (ACS) publishes the Diet and Physical Activity Guideline to serve as a foundation for its communication, policy, and community strategies and, ultimately, to affect dietary and physical activity patterns among Americans (Rock et al. 2020). According to their published report in 2020, cancer has been the second leading cause of death, exceeded only by heart disease, in both men and women in the United States. This guideline has, therefore, provided specific recommendations for health care professionals, policymakers, and the public regarding health behaviors related to maintaining a healthy body weight, being physically active, consuming a healthy diet, and avoiding or limiting alcohol intake to reduce cancer risk. According to this report of 2020, obesity has been clearly linked with an increased risk of several types of cancer, including the following: breast, colon, rectal, endometrial, esophagus, kidney, liver, ovarian, pancreas, stomach, thyroid, multiple myeloma, and meningioma. A clear link of diet, nutrition, obesity, and multiple forms of cancer has, therefore, been documented from this 2020 ACS guideline (Rock et al. 2020).

The follow-up ACS guideline 2022 has also been published and a healthy diet plan for cancer patients has been reported that included: foods that are high in nutrients in amounts that help achieve and maintain a healthy body weight; a variety of vegetables—dark green, red, and orange, fiber-rich legumes (beans and peas), and others; fruits, especially whole fruits with a variety of colors; and whole grains. This food plan limited or did not include red and processed meats, sugar-sweetened beverages, highly processed foods, refined grain products, and alcohol (Rock et al. 2022).

Although strong epidemiological associations exist between obesity and cancer, less is known about how diet might impact cancer once it has been diagnosed and particularly how diet can impact cancer treatment. According to a recent review, a positive cancer outcome due to dietary influences may be mediated via the hormonal, metabolic, and immune/inflammatory effects (Mittelman 2020). One review has examined the general mechanisms that link nutritional principles to immune function and the effectiveness of anticancer immunotherapy and proposed that nutrition can affect and potentially enhance the immune response against cancer (Soldati et al. 2018). The current scientific literature has suggested a "longevity everyday diet." This is a plant-based pesco-vegan diet containing high legume, high whole grain diet, nut consumption, which provides 45%–60% of calories from nonsrefined complex carbohydrates, 10%–15% proteins, and 25%–35% fats and appears to have the highest potential not only to prevent cancer but also to extend longevity and health span (Mishra et al. 2024).

Predictably, a greater intake of red and processed meat along with low consumption of fruits and vegetables has been reported to be associated with increased levels of inflammatory biomarkers that are implicated in cancer development. On the other hand, the consumption of phytosterols, vitamins, and minerals, which exert antioxidant and anti-inflammatory roles have been linked to lower cancer risk, or even its occurrence prevention (Ahmedah et al. 2024). Studies have indicated that the diet that include new, diversified, colorful, clean, nutrient-rich, energy-boosting, and raw food, increases apoptosis and autophagy, antioxidation, cell cycle arrest, anti-inflammation, and the immune response against breast cancer cells (Neagu et al. 2024). Similarly, nutrition and fasting could help prevent cancer and other age-related disorders that may be mediated in part by the reduction in the activity of the growth hormone/insulin-like-growth-factor-I axis (Fanti and Longo 2024). It is reported that a combined intervention of physical activity/exercise and diet/nutrition may decrease body weight, fat mass, insulin levels, and inflammation, and improve lipidemic profile, the physical component of quality of life, and depression in cancer patients and survivors (Dinas et al. 2024). Accordingly, many other diet plans show promises in cancer prevention/management that are included below.

3.4.1 | Plant-Primarily Based Diets

Consuming plant-based diets is safe and effective for all stages of the life cycle, from pregnancy and lactation, to childhood, to old age. Plant-based diets, highlighting the intake of fruits, vegetables, whole grains, legumes, nuts, and seeds, have been linked to a reduced risk of chronic diseases such as obesity, type 2 diabetes, cardiovascular diseases, and some types of cancer when studied among the adult population only (Müller 2020). However, a well-planned vegan diet must include adequate calories and nutrients, supplements such as vitamin B12, vitamin D, and other micronutrients (Łuszczki et al. 2023). Plant-based diets, which are high in fiber and polyphenolics, are also associated with a diverse gut microbiota, producing metabolites that have anti-inflammatory functions that may help manage disease processes. Plant based diet must ensure the adequate intake of a few nutrients, including vitamin B12, calcium, vitamin D, iron, zinc, and omega-3 fats (Craig et al. 2021).

Plant-based diets are either vegetarian (plant-based plus dairy products and/or eggs) or vegan (100% plant-based). Important characteristics of plant-based diets which would be expected to be beneficial for long-term health are low intakes of saturated fat and high intakes of dietary fiber, whereas potentially deleterious characteristics are the risk of low intakes of some micronutrients such as vitamin B_{12}, vitamin D, calcium and iodine, particularly in vegans. Vegetarians and vegans typically have lower BMI, serum LDL cholesterol and blood pressure than comparable regular meat-eaters, as well as lower bone mineral density. Moreover, vegetarians in the EPIC-Oxford study have a relatively low risk of IHD, diabetes, diverticular disease, kidney stones, cataracts and possibly some cancers, but a relatively high risk of stroke (principally hemorrhagic stroke) and bone fractures, in comparison with meat-eaters. Vegans in EPIC-Oxford have a lower risk of diabetes, diverticular disease and cataracts and a higher risk of fractures (Key et al. 2022). Such findings are supported by other studies showing that vegan or plant-based diets enhance the efficacy of breast cancer therapies (Khalifa et al. 2024). As a result, studies related to the benefit of plant-based diet in NCDs are ongoing and both observational and intervention studies reiterate that vegetarians have a lower risk of certain types of cancer, overall cancer, overweight-obesity, type 2 diabetes, dyslipidemia, hypertension, and vascular diseases (Baroni et al. 2024).

3.4.2 | The Mediterranean Diet (MD)

MD, known for prioritizing fruits, vegetables, whole grains, olive oil, fish, and moderate red wine consumption, has been linked to a lower risk of cancers (Castro-Espin and Agudo 2022). MD has attracted increasing attention for its rich content of antioxidants, polyphenols, and other bioactive compounds contributing to its ability to modulate gene expression, inhibit tumor growth, and regulate apoptosis (Reytor-González et al. 2024). Studies have shown significant reductions in inflammatory markers including C-reactive protein, tumor necrosis factor-alpha, and interleukin-6 among individuals adhering to the MD. Such findings have suggested a pivotal role of MD in mitigating chronic inflammation-associated with cancer development (Reytor-González et al. 2024). Recent studies have revealed that MD may prevent lung cancer and inhibit its development (Gao et al. 2024). Another review study has concluded that postmenopausal women who adhere to the MD can potentially reduce their risk of breast cancer whereas,

postmenopausal breast cancer patients can benefit from incorporating the MD into their eating habits (Yao 2024).

By carefully choosing cross-sectional analysis and systematic review, cohort study, narrative review, systematic review and meta-analysis, case-control study, randomized controlled trials, and cross-sectional study, a recent review has concluded that adherence to the MD correlates with improved quality of life measures and reduced mortality rates among women with breast cancer in older age groups. The diet's emphasis on antioxidant-rich foods, anti-inflammatory compounds, and healthy fats contributes to these observed benefits. Specific unsaturated fats such as omega-3 polyunsaturated fatty acids, docosahexaenoic acid, and eicosapentaenoic acid, demonstrated anti-cancer properties by modulating cancer cell behavior and enhancing treatment responses (Virani et al. 2024). Similarly, a pooled analysis from 15 clinical trials and 9 case-control studies encompassing a total of 2,217,404 subjects indicated that adherence to the Mediterranean diet significantly reduced the prevalence of colorectal cancer (Ungvari et al. 2024). The MD has also been found to reduce the risk of oral and oropharyngeal cancer by 43% (Shrivastava et al. 2024).

Recently, a review study examined 58 research reports consisted of randomized controlled trials, cohort studies, cross sectional studies, reviews and other meta-analyses in which 11 primary studies were related to the impact of a Mediterranean diet on sexual dysfunction, 9 primary studies regarding urinary symptoms, 8 primary studies regarding stone disease, and 9 primary studies regarding urologic cancers. Their results demonstrated that an MD was an effective means to prevent as well as improve erectile dysfunction, nephrolithiasis, lower urinary tract symptoms, and urinary incontinence. The review suggested for additional research to study the impact of diet on urologic cancers and other urologic conditions such as premature ejaculation, loss of libido, female sexual dysfunction, and overactive bladder (Sultan et al. 2024). The beneficial effects of MD have been indicated to be mediated by MD's ingredients such as yogurt and cheese. These foods provide calcium, phosphorus, fat, carbohydrates and protein, all nutrients influencing various systems including bone, cardiovascular system, intermediary metabolism, cancer, central nervous system, and inflammation. In addition, they contain prebiotics and provide probiotics which are capable of modifying microbiota composition and metabolism, potentially acting also indirectly on the various systems (Rizzoli and Biver 2024).

3.4.3 | Ketogenic Diet (KD)

KD has been reported to be an efficacious approach for weight-loss, improved glycemia, cognitive function, and cancer prognosis (Zemer et al. 2024). KD has antiproliferative and immunomodulatory effects as found in various preclinical cancer studies. Immune checkpoint blockade (ICB) is a part of the standard of care in the treatment of many forms of cancer though it lacks efficacy in some patients. As a result, adjunct therapies and dietary interventions are needed to support the antitumor immune response to less responsive patients where KD could play a significant role. For example, preclinical cancer studies have revealed increased activation of and infiltration by tumor-fighting immune cells, especially CD8+ T cells, but also M1 macrophages and natural killer cells, in response to a KD regimen. KD also showed synergism with ICB therapy in several preclinical tumor studies. The observed effects are ascribed to the ability of KD to improve immune cell infiltration and induce downregulation of immune-inhibitory processes, thus creating a more immunogenic tumor microenvironment. Therefore, studies showed that KD mediated alteration in the metabolic composition of the tumor microenvironment can boost the anti-tumor immune response and diminish immunotherapy-resistance (Stefan et al. 2024).

The dietary intervention by KD to deprive cancer cells of the preferred energy sources within the tumor microenvironment, thereby enhancing immune cell efficacy has also been reported in a recent review (Yang et al. 2024). The mechanism by which KD might intervene cancer cell metabolism has been reported in a recent review focusing on glioblastoma (GBM). It is the most aggressive primary brain tumor in adults, with a universally lethal prognosis despite maximal standard therapies. GBM cells require glucose as a source of carbon and ATP synthesis for tumor growth through glycolysis and glutamine to provide nitrogen, carbon, and ATP synthesis through glutaminolysis. The GBM review indicated that a ketogenic diet-drug combination could be effective in inhibiting glycolysis, glutaminolysis, and growth signaling while shifting energy metabolism to ketone bodies that can not support long-term bioenergetic and biosynthetic demands of cancer cell proliferation (Duraj et al. 2024).

3.4.4 | The Western Diet

The Western diet has been shown to be associated with an increased risk of various types of cancer, including colorectal cancers (CRC) (Oliveira et al. 2024). A review from 28 relevant studies have indicated that a Western dietary pattern correlates well with increased risk of CRC recurrence and development of disease/death (Fretwell et al. 2024). One of the risk factors for CRC is obesity, which is correlated with a high-fat diet prevalent in Western dietary habits. The association between an obesogenic high-fat diet and CRC has been established for several decades; yet, the mechanisms by which a high-fat diet increases the risk of CRC remain unclear. Recent studies indicate that gut microbiota strongly influence the pathogenesis of both high-fat diet-induced obesity and CRC. The gut microbiota is composed of about 2000 different bacterial species, some of which are implicated in CRC. In particular, the expansion of facultative anaerobic Enterobacteriaceae is considered a microbial signature of intestinal microbiota functional imbalance (dysbiosis) that is associated with both high-fat diet-induced obesity and CRC (Lee et al. 2024).

A mini review has reported that the Western diet with high inflammatory potential, glycemic and insulinemic loads, high consumption of refined grains, processed meats, and processed fish, was linked to an increased risk of glioma. Glioma is the most common type of brain cancer, associated with a high mortality rate. Diet is one of the modifiable factors that can

influence the risk of various cancers, including glioma. In contrast, research studies have suggested that adherence to healthy dietary patterns-such as the Mediterranean diet, Dietary Approaches to Stop Hypertension (DASH) diet, and vegetarian dietary patterns-may be associated with a reduced risk of glioma (Almasi et al. 2024). Neuroendocrine neoplasms (NENs) represent heterogeneous tumors arising from neuroendocrine cells in different organs that are similarly reported to be adversely affected by the Western diet. In contrast, MD and KD played a preventing role in tumor development (Massironi et al. 2024).

Dietary patterns, including the Western diet may be associated with an increased risk of prostate cancer (PC). Studies have reported an increase in the abundance of specific gut bacteria in PC patients. As such, diet and nutrition could influence PC via the involvement of gut microbiota (Matsushita et al. 2020). Western Diet and cholesterol contained in the diet has been shown to exacerbate hepatic accumulation of free cholesterol, resulting in toxic effects on the liver and altered cholesterol metabolism. Such alteration in liver metabolism could ultimately lead to the development of hepatocellular carcinoma, a most common type of primary liver cancer (J. Y. Kim et al. 2021).

3.4.5 | Overall Impact of Various Diet Plans on Cancer

Dietary patterns and specific dietary components along with the gut microbiota may jointly shape susceptibility, resistance and therapeutic response to cancer. Diet-microbial interactions via the intestinal colonization of opportunistic versus oncogenic bacteria to mitigate carcinogenesis have been reported. It is also reported that the diet-induced expansion of specific gut bacteria might drive colonic epithelial tumorigenesis or create immunopermissive tumor milieus (Nakatsu et al. 2024).

Gut microbes play an important role in cancer specially the gastrointestinal malignancies. An imbalance diet could weaken the immune system, leading to spreading and development of cancers. The triage of gut microbiome, host immune system, and dietary patterns might trigger the initiation of carcinogenesis. In addition to its role in carcinogenesis and tumor development, there is still growing evidence as to how intestinal microflora influences the efficacy and toxicity of chemotherapy and immunotherapy by the gut microbiome (Qazi et al. 2024).

Studies have reported that the cell-intrinsic nutrient sensing pathways respond to specific diet-derived cues to facilitate oncogenic transformation of pancreatic epithelial cells. Connection of specific food intake to pancreatic cancer progression has been reported that offers a promising target for therapeutic development to mitigate disease risk (Noè and Carrer 2024). Moreover, the short-chain fatty acids (SCFAs) such as butyrate, propionate, and acetate are microbial metabolites and their availability in the gut and other organs from diet shape the diversity and metabolism of the microbiota. SCFAs regulate epithelial barrier function, mucosal and systemic immunity via evolutionary conserved processes involving the G protein-coupled receptor signaling or histone deacetylase activity. The anti-inflammatory role of butyrate is mediated through direct effects on the differentiation of intestinal epithelial cells, phagocytes, B cells and plasma cells, and regulatory and effector T cells. Intestinally derived SCFAs also directly and indirectly affect immunity at extra-intestinal sites, such as the liver, the lungs, the reproductive tract and the brain, and have been implicated in a range of disorders, including infections, intestinal inflammation, autoimmunity, food allergies, asthma, and responses to cancer therapies (Mann et al. 2024).

A PubMed literature search covering the 2013–2023 period including 35 papers found limited evidence of high sugar intake associated with breast cancer incidence. Dairy and soy consumption, however, displayed a protective effect in most of the analyzed papers (Lalioti et al. 2024). Research studies have shown that the diabetes risk reduction diet (DRRD) score is inversely correlated with breast cancer risk. That is, for every three-point increase in the DRRD score, the risk of breast cancer decreases by 7%. As such, a higher DRRD score is associated with a reduced risk of cancer and a higher chance of survival (Hasani et al. 2024).

Overall, the ability to influence cancer incidence and outcomes through dietary changes is underutilized in clinical practice and insufficiently recognized among the public, healthcare professionals, and policymakers. Dietary changes offer the opportunity for autonomy and control over individuals' health outcomes. Research studies have revealed that specific dietary components, as well as cultural behaviors and epidemiological patterns may act as causative or protective factors in cancer development. Understanding the role of diet interventions would help the community and clinical environment for more effective cancer prevention and therapeutic strategies. Current research studies have identified key areas for improvement that include the development of more specific, widely accepted guidelines, promoting increased involvement of dieticians within cancer multidisciplinary teams, enhancing nutritional education for healthcare professionals and exploring the potential implementation of personalized nutrition tools. A greater understanding of the complex interactions between diet and cancer would facilitate informed clinical interventions and public health policies to reduce global cancer burden and improve care for cancer patients and survivors (Britten and Tosi 2024).

4 | Conclusion

The alarming rise of obesity, diabetes, CVD, and cancers warrant more detailed understanding on the role of precision nutrition and diet microbiome interaction mechanisms because gut microbiota influence various pathways for inflammation, proliferation, and apoptosis. This comprehensive review highlights the intricate relationship between diet and health outcomes, emphasizing the pivotal role of dietary plans in shaping individual well-being and health. The evolving nature of diets, influenced by cultural, economic, and social factors, warrants for a nuanced understanding of diverse dietary practices across the globe.

The impact of diet extends beyond personal health, with profound environmental implications. The current patterns of food consumption and production raise concerns about the sustainability

of our dietary choices. Amidst the wealth of information, there exists a challenge in defining what constitutes a healthy diet, leading to confusion among medical professionals. However, the consensus remains that every diet significantly influences daily life activity and health. A well-rounded and healthy diet plan should include a variety of foods with plant- and animal-based sources to provide essential nutrients crucial for overall health and the prevention of chronic diseases.

This review delves into specific diet types, offering insights into their nutritional content and health effects. Vegetarian and vegan diets, for instance, demonstrate health benefits in disease prevention and treatment, emphasizing the importance of proper planning and supplementation. The Mediterranean diet, rooted in traditional eating patterns, emerges as a well-studied and effective approach with various health benefits, including cancer risk reduction and improved cognitive function. The ketogenic diet, gaining popularity, shows promise in weight loss and improving cardiovascular health, but its long-term effects and safety warrant careful consideration and consultation with healthcare professionals. Conversely, the Western diet, characterized by high intake of processed and animal-based foods, contributes to the obesity epidemic and is linked to various chronic diseases.

This review emphasizes the need for ongoing research and a better understanding of the factors contributing to the quality of diets and their impact on health outcomes. Identifying gaps and challenges within the current knowledge base is crucial for guiding future research directions. As the global population continues to grow, promoting and sustaining optimal health requires a multifaceted approach, encompassing healthcare practices, individual behaviors, structured interventions, and advancements in healthcare knowledge. In the face of the complex interplay between diet, health, and societal factors, this review serves as a resource for guiding informed decisions and interventions aimed at improving overall well-being and addressing the challenges posed by the evolving landscape of global diets.

Author Contributions

Md. Mahbubar Rahman: conceptualization, writing – original draft. **Manisha Pandit:** data curation, formal analysis, methodology, resources. **Bhawana Thukral:** project administration, supervision. **Morshed M. Khandoker:** formal analysis, methodology, writing – review and editing.

Ethics Statement

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are openly available in PubMed and have been reported along with the corresponding DOI numbers with appropriate citation in the References.

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