



Extreme diet trends and cardiovascular risk: An overview

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Abstract

The increasing prevalence of obesity, metabolic syndrome, and lifestyle-related disorders has fueled the popularity of extreme dietary patterns as rapid strategies for weight loss and disease management. Diets such as ketogenic, carnivore, prolonged fasting, intermittent fasting, very-low-calorie diets, detox diets, raw food diets, fruitarian diets, and high-protein regimens have gained widespread attention through social media and celebrity endorsements. While many of these diets demonstrate short-term benefits, including weight reduction, improved glycemic control, and decreased body fat, their long-term cardiovascular safety remains controversial. Extreme dietary restriction may influence cardiovascular health through alterations in lipid metabolism, blood pressure regulation, endothelial function, inflammation, oxidative stress, insulin sensitivity, gut microbiota, and nutrient balance. Emerging evidence suggests that certain restrictive dietary patterns may increase low-density lipoprotein cholesterol (LDL-C), promote nutritional deficiencies, impair vascular function, and elevate cardiovascular risk in susceptible individuals, whereas evidence-based dietary approaches such as the Mediterranean and DASH diets consistently demonstrate cardioprotective effects. This review summarizes the current evidence regarding the physiological mechanisms, metabolic consequences, cardiovascular benefits and risks, clinical applications, and future research needs related to extreme diet trends. Understanding the balance between potential therapeutic benefits and adverse cardiovascular outcomes is essential for clinicians, dietitians, and public health professionals to provide evidence-based dietary recommendations.

Keywords: Extreme diets, Cardiovascular disease, Ketogenic diet, Carnivore diet, Intermittent fasting, Very-low-calorie diet, Atherosclerosis, Lipid profile, Hypertension

Introduction

Cardiovascular disease (CVD) remains the leading cause of morbidity and mortality worldwide, accounting for approximately 20.5 million deaths annually, representing nearly one-third of all global deaths, with ischemic heart disease and stroke being the predominant contributors (Roth *et al.*, 2020; World Health Organization [WHO], 2023) [14]. The growing prevalence of obesity, type 2 diabetes mellitus, hypertension, and metabolic syndrome has prompted increasing public interest in dietary strategies aimed at rapid weight loss and cardiometabolic improvement. Consequently, extreme diet trends, including ketogenic, carnivore, intermittent fasting, one-meal-a-day (OMAD), very-low-calorie diets, prolonged fasting, fruitarian, raw food, and juice detox diets, have gained remarkable popularity over the past decade. Much of this popularity has been driven by social media platforms, celebrity endorsements, fitness influencers, and online health communities that frequently promote dramatic health transformations without adequate scientific validation (Turner-McGrievy *et al.*, 2021) [9]. Although several of these dietary approaches have demonstrated short-term benefits such as weight reduction, improved insulin sensitivity, and better glycemic control, concerns remain regarding their long-term effects on lipid metabolism, endothelial function, inflammation, micronutrient adequacy, cardiac rhythm, and overall cardiovascular health. Scientific evidence regarding the safety and efficacy of many extreme diets remains inconsistent, with some studies reporting cardiometabolic benefits while others suggest increased low-density lipoprotein cholesterol (LDL-C), nutritional deficiencies,

arrhythmias, and elevated cardiovascular risk, particularly among susceptible populations (Ludwig *et al.*, 2022; Lichtenstein *et al.*, 2021) [6, 7]. Therefore, an evidence-based evaluation of these dietary patterns is essential to distinguish scientifically supported interventions from popular but potentially harmful nutritional practices. The primary aim of this review is to critically evaluate the current evidence regarding extreme diet trends and their relationship with cardiovascular risk by examining their physiological mechanisms, effects on cardiovascular risk factors, clinical outcomes, potential benefits, limitations, and future research priorities to guide evidence-based dietary recommendations for clinicians, nutritionists, researchers, and public health professionals.

Cardiovascular Disease: A Global Health Challenge

Cardiovascular disease (CVD) is the foremost cause of mortality and disability worldwide, posing an enormous challenge to healthcare systems, economies, and public health. According to the Global Burden of Disease (GBD) Study 2019, approximately 523 million people were living with cardiovascular disease, and an estimated 18.6 million deaths occurred globally in 2019, increasing to nearly 20.5 million deaths annually in recent estimates, accounting for approximately one-third of all global deaths (Roth *et al.*, 2020; World Health Organization [WHO], 2023) [14]. Ischemic heart disease and stroke remain the leading contributors, with more than 75% of cardiovascular deaths occurring in low- and middle-income countries where access to preventive healthcare and early treatment is often limited. The global rise in CVD is largely driven by

modifiable risk factors, including hypertension, dyslipidemia, obesity, diabetes mellitus, tobacco use, excessive alcohol consumption, physical inactivity, chronic stress, and population aging (Visseren *et al.*, 2021) ^[11]. Among these determinants, diet plays a pivotal role in both the development and prevention of cardiovascular disease. Diets high in saturated fats, trans fats, refined carbohydrates, sodium, added sugars, and ultra-processed foods contribute to obesity, insulin resistance, hypertension, systemic inflammation, endothelial dysfunction, and atherosclerosis, whereas dietary patterns rich in fruits, vegetables, whole grains, legumes, nuts, fish, and unsaturated fats, such as the Mediterranean and DASH diets, are consistently associated with reduced cardiovascular morbidity and mortality (Lichtenstein *et al.*, 2021) ^[6]. In recent years, the popularity of extreme dietary patterns has introduced new questions regarding their long-term cardiovascular safety, particularly concerning lipid metabolism, vascular function, and nutrient adequacy. Beyond its health consequences, CVD imposes an enormous economic burden through direct medical expenditures, long-term pharmacological treatment, hospitalizations, rehabilitation, and indirect costs resulting from reduced productivity, disability, and premature mortality. The global economic cost of cardiovascular disease is projected to exceed US\$1 trillion annually by 2030, disproportionately affecting low-resource settings where healthcare infrastructure is limited (Bloom *et al.*, 2011) ^[1]. Consequently, reducing the burden of cardiovascular disease requires comprehensive public health strategies emphasizing evidence-based nutrition, lifestyle modification, early risk assessment, and equitable access to preventive healthcare services.

Definition and Classification of Extreme Diets

Extreme diets are dietary regimens characterized by severe restriction or excessive emphasis on specific food groups, nutrients, or eating patterns with the primary goals of achieving rapid weight loss, improving metabolic health, enhancing physical performance, or preventing chronic diseases. Unlike balanced dietary approaches recommended by major health organizations, extreme diets often involve substantial deviations from established nutritional guidelines by markedly reducing or eliminating carbohydrates, fats, or entire food categories, prolonging fasting periods, or relying on highly restrictive eating schedules. While some of these dietary strategies have demonstrated short-term benefits in weight management and glycemic control, their long-term safety, nutritional adequacy, sustainability, and cardiovascular implications remain subjects of ongoing scientific debate. The increasing popularity of these diets has been largely driven by social media, celebrity endorsements, fitness influencers, and widespread online dissemination of anecdotal success stories rather than robust clinical evidence (Lichtenstein *et al.*, 2021; Ludwig *et al.*, 2022) ^[6, 7]. Based on their nutritional composition and eating patterns, extreme diets can be classified as follows.

1. Ketogenic Diet

The ketogenic diet (KD) is a very low-carbohydrate, high-fat, and moderate-protein dietary pattern that typically provides approximately 70–80% of total energy from fat, 10–20% from protein, and less than 5–10% from carbohydrates (usually below 50 g/day). Severe carbohydrate restriction induces a metabolic state known as nutritional ketosis, in which hepatic ketone bodies become

the primary energy source instead of glucose. Originally developed for the treatment of refractory epilepsy, the ketogenic diet has gained widespread popularity for weight loss, diabetes management, and athletic performance. Short-term studies report improvements in body weight, insulin sensitivity, and triglyceride levels; however, concerns remain regarding elevated low-density lipoprotein cholesterol (LDL-C), reduced dietary fiber intake, micronutrient deficiencies, and uncertain long-term cardiovascular safety (Kosinski & Jornayvaz, 2017) ^[3].

2. Carnivore Diet

The carnivore diet is one of the most restrictive dietary approaches, consisting exclusively or predominantly of animal-derived foods such as meat, poultry, fish, eggs, and certain dairy products while eliminating fruits, vegetables, legumes, grains, nuts, and seeds. Advocates claim benefits including weight loss, improved autoimmune symptoms, enhanced mental clarity, and reduced inflammation. However, this diet is typically high in saturated fat and cholesterol while being deficient in dietary fiber, vitamin C, folate, phytochemicals, and several antioxidants. The long-term cardiovascular consequences remain uncertain, with concerns regarding increased LDL cholesterol, altered gut microbiota, endothelial dysfunction, and elevated trimethylamine N-oxide (TMAO) production associated with high red meat consumption (Leroy & Cofnas, 2020) ^[5].

3. Very-Low-Calorie Diet (VLCD)

A very-low-calorie diet (VLCD) provides fewer than 800 kcal per day and is generally prescribed under medical supervision for individuals with severe obesity requiring rapid weight reduction. These diets often consist of commercially formulated meal replacements designed to supply adequate protein, vitamins, and minerals despite severe energy restriction. VLCDs can produce substantial short-term weight loss and improvements in blood pressure, glycemic control, and insulin sensitivity. Nevertheless, prolonged adherence may lead to muscle loss, gallstone formation, electrolyte imbalance, nutritional deficiencies, cardiac arrhythmias, and weight regain following cessation of the diet (Lean *et al.*, 2018) ^[4].

4. Intermittent Fasting

Intermittent fasting (IF) refers to dietary strategies that alternate periods of normal eating with scheduled fasting intervals without necessarily restricting total caloric intake. Common forms include the 16:8 time-restricted eating method, 5:2 fasting, and alternate-day fasting. IF has been associated with improvements in body weight, insulin sensitivity, lipid metabolism, oxidative stress, and blood pressure. These benefits are thought to result from metabolic switching between glucose and fatty acid oxidation, enhanced autophagy, and improved circadian rhythm regulation. Although generally considered safe for healthy adults, its long-term cardiovascular benefits remain under investigation (de Cabo & Mattson, 2019) ^[2].

5. One-Meal-a-Day (OMAD)

The One-Meal-a-Day (OMAD) diet is an extreme form of time-restricted eating in which individuals consume all daily calories within a single meal while fasting for approximately 23 hours each day. OMAD aims to maximize fat oxidation and improve metabolic flexibility through

prolonged fasting. While some individuals experience weight loss and reduced caloric intake, prolonged fasting periods may increase hunger, fatigue, nutrient inadequacy, hypoglycemia in susceptible individuals, and reduced adherence. Current scientific evidence regarding its long-term cardiovascular safety remains limited.

6. Water Fasting

Water fasting involves complete abstinence from all food while consuming only water for periods ranging from 24 hours to several days or even weeks under specialized supervision. During prolonged fasting, glycogen stores become depleted, resulting in ketosis, lipolysis, and protein catabolism. Although short-term fasting may reduce blood pressure, body weight, and inflammatory markers, prolonged water fasting may lead to dehydration, electrolyte imbalance, hypotension, cardiac arrhythmias, muscle wasting, vitamin deficiencies, and refeeding syndrome upon resumption of normal eating (Wilhelmi de Toledo *et al.*, 2019)^[13].

7. Juice Detox Diets

Juice detox diets, also known as juice cleanses, consist primarily of fruit and vegetable juices while excluding most solid foods for several days. These diets are marketed as methods to eliminate toxins, improve digestion, promote rapid weight loss, and enhance overall wellness. However, scientific evidence supporting detoxification claims is lacking because the liver and kidneys naturally perform detoxification processes. Juice-based diets are typically low in protein, dietary fiber, and essential fatty acids while often containing high amounts of natural sugars, potentially leading to glycemic fluctuations and inadequate nutrient intake if followed for prolonged periods.

8. Fruitarian Diet

The fruitarian diet is an extremely restrictive vegan dietary pattern composed predominantly of fruits, with limited consumption of nuts, seeds, and selected vegetables. Followers believe that consuming primarily raw fruits promotes detoxification, longevity, and disease prevention. Although fruitarian diets provide abundant vitamins, antioxidants, and phytochemicals, they are severely deficient in protein, vitamin B12, calcium, vitamin D, iron, zinc, omega-3 fatty acids, and essential amino acids. Long-term adherence may increase the risk of malnutrition, reduced bone mineral density, muscle loss, anemia, and adverse cardiovascular outcomes associated with nutritional deficiencies.

9. Raw Food Diet

The raw food diet emphasizes consumption of uncooked or minimally heated foods, generally avoiding cooking temperatures above 42–48°C to preserve enzymes and heat-sensitive nutrients. Raw food diets primarily include fruits, vegetables, nuts, seeds, sprouts, and occasionally raw dairy or raw fish. While increasing intake of plant-based foods may improve antioxidant consumption, prolonged adherence may result in inadequate energy intake, protein deficiency, vitamin B12 deficiency, calcium insufficiency, and reduced bioavailability of certain nutrients. Concerns also exist regarding foodborne infections from consuming raw animal products.

10. High-Protein Diets

High-protein diets typically provide more than 25–30% of total daily energy from protein or exceed 1.6 g protein/kg body weight/day. These diets are widely used for weight management because protein enhances satiety, preserves lean body mass, and increases thermogenesis. Protein sources may include lean meats, poultry, fish, dairy products, eggs, legumes, and protein supplements. Although high-protein diets can improve body composition and glycemic control, excessive intake of red and processed meats has been associated with increased saturated fat intake, elevated cardiovascular risk, chronic kidney disease progression in susceptible individuals, and alterations in gut microbiota composition.

11. Paleo Diet

The Paleolithic (Paleo) diet is based on the presumed dietary patterns of prehistoric hunter-gatherers and emphasizes consumption of lean meats, fish, eggs, fruits, vegetables, nuts, and seeds while excluding grains, legumes, dairy products, refined sugars, and processed foods. Advocates suggest that the human genome is better adapted to ancestral dietary patterns than to modern processed diets. Clinical studies have demonstrated improvements in body weight, insulin sensitivity, blood pressure, and lipid profiles; however, exclusion of dairy products and whole grains may reduce calcium, vitamin D, and dietary fiber intake, and the long-term cardiovascular effects require further investigation.

Physiological Effects of Extreme Diets

Extreme diets induce a wide range of physiological adaptations that influence metabolism, endocrine function, and cardiovascular health through alterations in nutrient availability and energy utilization. Severe carbohydrate restriction or prolonged fasting shifts energy metabolism from glucose oxidation to fatty acid oxidation, leading to hepatic production of ketone bodies (β -hydroxybutyrate, acetoacetate, and acetone), a metabolic state known as ketosis, which serves as an alternative energy source for the brain and peripheral tissues (de Cabo & Mattson, 2019)^[2]. This metabolic switch is accompanied by significant hormonal adaptations, including reduced insulin secretion, increased glucagon release, enhanced catecholamine activity, and elevated growth hormone levels, collectively promoting lipolysis, gluconeogenesis, and fat oxidation while preserving blood glucose during periods of limited carbohydrate intake. Extreme diets also exert marked effects on lipid metabolism, often lowering serum triglycerides and increasing high-density lipoprotein cholesterol (HDL-C); however, diets rich in saturated fats, such as ketogenic and carnivore diets, may substantially increase low-density lipoprotein cholesterol (LDL-C) and apolipoprotein B concentrations in susceptible individuals, potentially increasing atherosclerotic cardiovascular risk (Ludwig *et al.*, 2022)^[7]. Furthermore, carbohydrate restriction and caloric reduction improve glucose homeostasis by enhancing insulin sensitivity, decreasing hepatic glucose production, and reducing postprandial glycemic excursions, thereby benefiting individuals with obesity and type 2 diabetes mellitus. Extreme dietary regimens also influence appetite regulation through alterations in appetite-related hormones, including reduced ghrelin levels and increased secretion of peptide YY (PYY), glucagon-like peptide-1 (GLP-1), and

leptin sensitivity, which contribute to enhanced satiety and spontaneous reductions in energy intake. Additionally, substantial dietary modifications alter the composition and diversity of the gut microbiota, influencing microbial metabolites such as short-chain fatty acids and trimethylamine N-oxide (TMAO), which are increasingly recognized as important mediators of inflammation, lipid metabolism, immune regulation, and cardiovascular health. While some extreme diets may improve metabolic parameters in the short term, persistent alterations in gut microbial ecology, nutrient availability, and lipid metabolism may also contribute to adverse cardiovascular outcomes, highlighting the importance of evaluating both their immediate benefits and long-term physiological consequences (Lichtenstein *et al.*, 2021; Valdes *et al.*, 2018) [6, 10].

Cardiovascular Risk Factors Influenced by Extreme Diets

Extreme dietary patterns exert profound effects on multiple cardiovascular risk factors through alterations in energy balance, lipid metabolism, glucose regulation, vascular function, and inflammatory pathways. Depending on their composition and duration, these diets may produce both beneficial and adverse cardiovascular outcomes. Calorie restriction and carbohydrate-limited diets frequently reduce blood pressure through weight loss, improved insulin sensitivity, and decreased sodium retention, while some fasting regimens have also demonstrated antihypertensive effects (Visseren *et al.*, 2021) [11]. Extreme diets significantly influence dyslipidemia, often lowering serum triglycerides and increasing high-density lipoprotein cholesterol (HDL-C); however, high-fat dietary patterns such as ketogenic and carnivore diets may substantially elevate low-density lipoprotein cholesterol (LDL-C), apolipoprotein B (ApoB), and non-HDL cholesterol in susceptible individuals, thereby potentially increasing atherosclerotic cardiovascular disease (ASCVD) risk (Ludwig *et al.*, 2022) [7]. Most extreme diets promote reductions in obesity and visceral adiposity through negative energy balance, increased fat oxidation, and appetite suppression, leading to improvements in waist circumference and body composition. These changes often enhance insulin sensitivity, improve glucose homeostasis, and reduce the risk of type 2 diabetes mellitus, particularly among individuals with obesity or metabolic syndrome. Nevertheless, prolonged adherence to highly restrictive diets may result in nutrient deficiencies that compromise long-term metabolic health. Extreme diets also modulate systemic inflammation by influencing circulating inflammatory biomarkers such as C-reactive protein (CRP), interleukin-6 (IL-6), and tumor necrosis factor-alpha (TNF- α), although findings remain inconsistent across different dietary approaches. Additionally, dietary composition influences oxidative stress, with plant-based diets generally enhancing antioxidant status, whereas diets rich in saturated fat and processed meat may increase reactive oxygen species production and lipid peroxidation. These metabolic alterations directly affect endothelial function, a critical determinant of vascular health, by regulating nitric oxide bioavailability, endothelial inflammation, and vascular reactivity. Persistent endothelial dysfunction may ultimately contribute to arterial stiffness, impaired vascular compliance, accelerated atherosclerosis, and increased

cardiovascular morbidity. Consequently, while several extreme diets may provide short-term improvements in selected cardiometabolic risk factors, their long-term cardiovascular safety depends on overall nutrient quality, dietary sustainability, individual metabolic responses, and careful clinical monitoring (Lichtenstein *et al.*, 2021; de Cabo & Mattson, 2019) [2, 6].

Individual Diet Trends and Cardiovascular Risk

Ketogenic Diet

The ketogenic diet (KD) is characterized by severe carbohydrate restriction, moderate protein intake, and high fat consumption, which induces a metabolic state of ketosis whereby ketone bodies become the primary energy source instead of glucose. The diet has gained popularity because of its effectiveness in promoting rapid weight loss, improving glycemic control, reducing insulin resistance, and lowering serum triglyceride levels. Several studies have reported favorable effects on body weight, blood pressure, and markers of metabolic syndrome, particularly among individuals with obesity and type 2 diabetes mellitus (Kosinski & Jornayvaz, 2017) [3]. However, concerns have emerged regarding significant elevations in low-density lipoprotein cholesterol (LDL-C), apolipoprotein B (ApoB), and saturated fat intake in some individuals, which may increase atherosclerotic cardiovascular disease (ASCVD) risk. Although short-term studies demonstrate metabolic benefits, evidence regarding long-term cardiovascular outcomes remains limited and inconsistent, warranting careful clinical monitoring and individualized dietary counseling.

Carnivore Diet

The carnivore diet is an extremely restrictive dietary pattern consisting almost entirely of animal-derived foods, including meat, fish, eggs, and selected dairy products, while excluding all plant foods. Nutritionally, it provides abundant protein, vitamin B12, iron, zinc, and essential amino acids but lacks dietary fiber, vitamin C, folate, and numerous phytochemicals. One of the major cardiovascular concerns associated with the carnivore diet is substantial LDL cholesterol elevation, which has been documented in many adherents due to high intakes of saturated fat and cholesterol. The absence of dietary fiber may adversely affect gut microbiota diversity and reduce short-chain fatty acid production, both of which play protective roles in cardiovascular health. Long-term concerns include increased cardiovascular risk, endothelial dysfunction, chronic inflammation, micronutrient deficiencies, and altered gut microbial metabolism, although robust long-term clinical studies remain scarce (Leroy & Cofnas, 2020) [5].

Intermittent Fasting

Intermittent fasting (IF) encompasses various eating patterns that alternate periods of feeding and fasting, including time-restricted eating (TRE) and alternate-day fasting (ADF). TRE typically limits food intake to a specific daily window, whereas ADF alternates fasting days with unrestricted eating days. Intermittent fasting promotes metabolic switching from glucose utilization to fatty acid oxidation, improving insulin sensitivity, body weight, blood pressure, and lipid metabolism. Clinical studies have demonstrated reductions in body mass index (BMI), fasting glucose, triglycerides, inflammatory biomarkers, and cardiovascular

risk factors. Emerging evidence suggests that IF may also improve endothelial function, circadian rhythm regulation, and cellular stress resistance. However, the long-term cardiovascular effects and sustainability of these approaches require further investigation (de Cabo & Mattson, 2019) [2].

Very-Low-Calorie Diet (VLCD)

Very-low-calorie diets provide fewer than 800 kcal/day and are frequently utilized under medical supervision for rapid weight reduction in individuals with severe obesity. Significant benefits include marked weight loss, reductions in visceral fat, improved glycemic control, lowered blood pressure, and favorable changes in lipid profiles. Clinical trials have demonstrated remission of type 2 diabetes in some patients following structured VLCD interventions. Nevertheless, safety concerns include gallstone formation, lean body mass loss, electrolyte imbalance, nutritional deficiencies, fatigue, and potential cardiac arrhythmias if not appropriately monitored. Therefore, VLCDs should be implemented only under professional supervision and for limited durations (Lean *et al.*, 2018) [4].

Water Fasting

Water fasting involves complete abstinence from food while consuming only water for a defined period. Metabolically, water fasting induces glycogen depletion, ketosis, increased lipolysis, reduced insulin concentrations, and enhanced autophagy. Short-term fasting may improve blood pressure, body weight, insulin sensitivity, and inflammatory markers. However, prolonged fasting can lead to dehydration, electrolyte disturbances, hypotension, nutrient deficiencies, muscle wasting, and serious cardiovascular complications including arrhythmias and syncope. Individuals with chronic diseases, diabetes, or cardiovascular conditions may be particularly vulnerable to adverse outcomes, emphasizing the need for medical supervision (Wilhelmi de Toledo *et al.*, 2019) [13].

Juice Cleanses

Juice cleanses or detox diets typically involve consuming fruit and vegetable juices while eliminating solid foods for several days. Although these diets are widely marketed for detoxification and rapid weight loss, scientific evidence supporting detoxification claims remains limited. Weight loss observed during juice cleanses is largely attributable to caloric restriction and fluid loss rather than elimination of toxins. Furthermore, these diets often provide inadequate protein, fiber, essential fatty acids, and several micronutrients, potentially resulting in unstable blood glucose levels, muscle loss, reduced satiety, and poor long-term sustainability. Consequently, juice cleanses are generally not recommended as evidence-based cardiovascular health interventions.

Fruitarian Diet

The fruitarian diet is one of the most restrictive plant-based dietary patterns, consisting predominantly of fruits with limited intake of nuts, seeds, and selected vegetables. While fruits provide substantial amounts of vitamins, antioxidants, and phytochemicals, exclusive reliance on fruit may result in deficiencies of protein, vitamin B12, calcium, iron, zinc, vitamin D, and omega-3 fatty acids. Such deficiencies may contribute to anemia, reduced bone health, muscle wasting, and impaired cardiovascular function. Additionally,

excessive fructose intake from large quantities of fruit may adversely affect triglyceride metabolism and hepatic lipid accumulation in susceptible individuals. Therefore, the cardiovascular implications of long-term fruitarian diets remain concerning due to nutritional inadequacy.

Paleo Diet

The Paleolithic (Paleo) diet emphasizes consumption of foods presumed to be available during the Paleolithic era, including lean meats, fish, fruits, vegetables, nuts, and seeds while excluding grains, legumes, dairy products, and processed foods. Current evidence suggests that Paleo diets may improve body weight, blood pressure, insulin sensitivity, and certain lipid parameters in the short term. Increased consumption of whole foods and reduced intake of ultra-processed foods likely contribute to these benefits. However, exclusion of whole grains and dairy products may reduce dietary fiber, calcium, and vitamin D intake, and long-term cardiovascular outcome data remain limited. Additional studies are required to establish the long-term safety and efficacy of this dietary pattern.

High-Protein Diets

High-protein diets are commonly used for weight management because protein increases satiety, preserves lean body mass, and enhances thermogenesis. Studies indicate that high-protein diets can improve body composition, facilitate weight loss, and enhance glycemic control. However, cardiovascular outcomes depend largely on protein source. Diets emphasizing plant proteins, fish, and lean poultry are generally associated with favorable cardiovascular effects, whereas excessive consumption of red and processed meats may increase saturated fat intake, inflammation, and cardiovascular risk. Long-term adherence to high-protein diets should therefore prioritize high-quality protein sources while maintaining overall dietary balance to optimize cardiovascular health (Lichtenstein *et al.*, 2021) [6].

Molecular Mechanisms Linking Extreme Diets and Cardiovascular Disease

Extreme dietary patterns influence cardiovascular health through multiple interconnected molecular pathways involving lipid metabolism, inflammation, oxidative stress, endothelial function, insulin signaling, and the gut microbiome. Diets rich in saturated fats and animal products, such as ketogenic and carnivore diets, may increase circulating low-density lipoprotein cholesterol (LDL-C) and apolipoprotein B (ApoB), promoting lipid accumulation within the arterial wall and accelerating atherosclerosis through macrophage activation and foam cell formation (Lichtenstein *et al.*, 2021) [6]. Conversely, calorie restriction and intermittent fasting can improve insulin sensitivity, reduce adiposity, and suppress inflammatory signaling pathways, thereby lowering cardiovascular risk. Extreme diets also modulate oxidative stress by altering the balance between reactive oxygen species (ROS) production and antioxidant defense mechanisms; diets deficient in fruits, vegetables, and dietary antioxidants may increase oxidative damage to vascular endothelial cells, whereas plant-rich dietary patterns enhance antioxidant capacity. Chronic inflammation, characterized by elevated levels of C-reactive protein (CRP), interleukin-6 (IL-6), and tumor necrosis factor-alpha (TNF-α), contributes to endothelial injury and plaque

instability, and dietary composition significantly influences these inflammatory mediators. Furthermore, extreme diets affect endothelial dysfunction by regulating nitric oxide (NO) bioavailability, vascular inflammation, and arterial compliance, thereby influencing blood pressure and vascular reactivity. Emerging evidence also highlights the pivotal role of the gut microbiome, where diets high in red meat and low in dietary fiber alter microbial composition and increase production of trimethylamine N-oxide (TMAO), a metabolite strongly associated with atherosclerosis, thrombosis, and adverse cardiovascular events. Additionally, prolonged nutritional imbalance may influence blood coagulation, platelet activation, and cardiac remodeling through metabolic, hormonal, and inflammatory pathways, collectively affecting myocardial structure and function. These complex molecular interactions demonstrate that the cardiovascular effects of extreme diets depend not only on caloric intake but also on dietary composition, nutrient quality, duration of adherence, and individual metabolic responses, emphasizing the importance of evidence-based nutritional recommendations for long-term cardiovascular health (Visseren *et al.*, 2021; Wang *et al.*, 2019) ^[11, 12].

Conclusion

Extreme dietary patterns continue to gain popularity because of their potential for rapid weight loss and metabolic improvement; however, their long-term effects on cardiovascular health remain uncertain. While ketogenic diets, intermittent fasting, and very-low-calorie diets may improve body weight, glycemic control, and selected cardiometabolic markers in the short term, highly restrictive approaches such as carnivore, fruitarian, and prolonged fasting diets may increase the risk of nutrient deficiencies, dyslipidemia, endothelial dysfunction, and adverse cardiovascular outcomes in susceptible individuals. Current evidence consistently supports balanced dietary patterns, particularly the Mediterranean and DASH diets, as the most effective and sustainable approaches for reducing cardiovascular risk. Future research should focus on long-term cardiovascular outcomes, individualized dietary interventions, and mechanistic studies to clarify the safety and efficacy of emerging diet trends.

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