

The Impact of Plant-Based Diets on Cardiovascular Health: A Comprehensive Review

Farinde Tobi David¹, Moses Adondua Abah^{2,3}, Micheal Abimbola Oladosu^{3,4}, Ochuele Dominic Agida^{2,3},
Njemanze Obinna Clive⁵, Adefisayo Modinat Adebukola⁶, Okwah Micah Nnabuko⁷
and Onuorah Uju Maryanne^{8,9}

¹Department of Human Nutrition and Dietetics, Faculty of Public Health, School: University of Ibadan, Ibadan, Oyo State, Nigeria

²Department of Biochemistry, Faculty of Biosciences, Federal University Wukari, Taraba State, Nigeria

³ResearchHub Nexus Institute, Nigeria

⁴Department of Biochemistry, Faculty of Basic Medical Sciences, University of Lagos, Lagos State, Nigeria

⁵Department of Chemistry/Biochemistry, School of Industrial and Applied Sciences, Federal Polytechnic Nekede, Owerri, Imo State, Nigeria

⁶Department of Human Physiology, Faculty of Basic Medical Sciences, University of Technology Akure, Ondo State, Nigeria

⁷Department of Chronic Disease Epidemiology, Yale school of Public Health, Yale University, New Haven, Connecticut, United States

⁸Department of International Public Health, Liverpool School of Tropical Medicine, Pembroke Place, Liverpool, United Kingdom

⁹Department of Pharmacy and Health and Nutrition Sciences, University of Calabria, Italy

Citation: Farinde Tobi David, Moses Adondua Abah, Micheal Abimbola Oladosu, Ochuele Dominic Agida, Njemanze Obinna Clive, Adefisayo Modinat Adebukola, Okwah Micah Nnabuko and Onuorah Uju Maryanne (2025). The Impact of Plant-Based Diets on Cardiovascular Health: A Comprehensive Review. *Plant Science Archives*. DOI: <https://doi.org/10.51470/PSA.2025.10.4.51>

Corresponding Author: Moses Adondua Abah | E-Mail: m.abah@fuwukari.edu.ng

Received 07 August 2025 | Revised 05 September 2025 | Accepted 10 October 2025 | Available Online 01 November 2025

ABSTRACT

Over the past decade, interest in plant-based diets has grown substantially, driven by evidence linking these dietary patterns to improved cardiometabolic outcomes and reduced environmental impact. This comprehensive review synthesizes research from 2010 to 2025, examining the relationship between plant-based diets and cardiovascular health. Across large prospective cohort studies, greater adherence to plant-based or vegetarian dietary patterns is consistently associated with lower risks of coronary heart disease, stroke, and cardiovascular mortality. Randomized and controlled intervention trials demonstrate favorable effects on key risk factors, including reductions in low-density lipoprotein cholesterol, blood pressure, body weight, and systemic inflammation. Mechanistic investigations attribute these benefits to the high content of dietary fiber, unsaturated fatty acids, antioxidants, and phytochemicals, alongside lower intakes of saturated fat and cholesterol. Additional pathways involve modulation of the gut microbiome, improved endothelial function, and reduced oxidative stress. Despite these advantages, plant-based diets may present nutritional challenges, particularly regarding vitamin B12, iron, calcium, and omega-3 fatty acid adequacy, which require informed dietary planning or supplementation. Current evidence supports the integration of healthful plant-based dietary patterns into cardiovascular disease prevention and management guidelines. However, further research, particularly long-term randomized trials and studies in diverse populations, is needed to strengthen causal inference and optimize implementation strategies. Overall, plant-based diets, when well designed and minimally processed, represent a nutritionally adequate and cardioprotective approach with significant implications for both human and planetary health.

Keywords: Plant-based diet, Cardiovascular disease, Vegetarian; Lipid profile and Hypertension.

Introduction

Cardiovascular disease (CVD) continues to be the world's leading cause of death, responsible for roughly one-third of global mortality [1]. It was estimated that 19.8 million people died from CVDs in 2022, representing approximately 32% of all global deaths. Of these deaths, 85% were due to heart attack and stroke. Out of the 18 million premature deaths (under the age of 70) due to noncommunicable diseases in 2021, at least 38% were caused by CVDs [2]. The prevalence of CVD remains high despite advances in treatment, largely due to persistent lifestyle-related risk factors such as poor diet quality, obesity, and physical inactivity. As illustrated in Figure 1, dietary excesses in saturated fats, refined sugars, and pro-inflammatory nutrients drive oxidative stress and metabolic dysregulation central to CVD pathogenesis. Nutrition research has evolved beyond the study of isolated nutrients to emphasize whole dietary patterns, recognizing that combinations of foods exert synergistic effects on lipids, blood pressure, glucose metabolism, and inflammation. This paradigm shift underscores that the overall quality of one's diet influences cardiovascular outcomes more profoundly than the intake of individual nutrients [3, 4].

Consequently, plant-based dietary patterns have emerged as a cornerstone of modern cardiovascular prevention strategies. Plant-based diet encompasses a range of eating patterns from vegan and vegetarian diets to more flexible approaches such as pescatarian, flexitarian, and whole-food plant-based (WFPB) regimens [5]. These diets emphasize fruits, vegetables, legumes, whole grains, nuts and seeds while limiting or excluding animal-derived foods and refined products. However, the health effects of plant-based diets depend greatly on food quality. Distinguishing between healthful and unhealthful plant-based patterns has become critical, as only the former, characterized by nutrient-dense, minimally processed foods, consistently demonstrate cardiometabolic benefits [6, 7]. This distinction, operationalized through the Healthful and Unhealthful Plant-Based Diet Indices (hPDI and uPDI), reinforces that plant-based eating is not inherently healthy unless it prioritizes whole-food sources of plant nutrients [8].

During the past decade, accumulating evidence from large cohort studies and clinical trials has linked plant-based diets to substantial reductions in cardiovascular risk [9]. Prospective studies such as the Nurses' Health Study and the Health Professionals Follow-Up Study have demonstrated inverse associations between adherence to high-quality plant-based

dietary patterns and the incidence of coronary heart disease, stroke, and cardiovascular mortality [10, 11]. Randomized and pragmatic intervention trials further support these observations: adoption of plant-forward or WFPB diets significantly improves low-density lipoprotein cholesterol (LDL-C), systolic blood pressure, and inflammatory biomarkers, all of which contribute to atherogenesis [11, 12]. Collectively, these data indicate that shifting dietary intake toward plant-dominant patterns can meaningfully reduce both clinical and subclinical markers of cardiovascular risk. As shown in Figure 1, these diets exert multiple synergistic effects on cardiometabolic pathways, from lowering cholesterol, low-density lipoprotein cholesterol (LDL-C) to reducing the risk of atherosclerosis [13]. Mechanistic research provides a biological rationale for these findings. Plant-based diets are naturally rich in unsaturated fatty acids, dietary fiber, potassium, magnesium, and antioxidant phytochemicals while low in saturated fat and cholesterol, features that improve lipid metabolism, endothelial function, and oxidative balance [14]. Beyond human studies, experimental research continues to clarify molecular pathways. For instance, [15] reported that a *Lactuca sativa*-supplemented diet significantly reduced lipid concentrations in Poloxamer-407-induced hyperlipidemic rats, demonstrating the lipid-modulating potential of plant-derived bioactives in vivo. Such translational evidence complements human mechanistic studies showing favorable modulation of the gut microbiome and reduced production of trimethylamine N-oxide (TMAO), a metabolite implicated in vascular inflammation and atherogenesis [16].

This review aims to provide a comprehensive synthesis of evidence published between 2010 and 2025 concerning the effects of plant-based dietary patterns on cardiovascular health. Its purpose is to delineate the evolving definitions of plant-based diets and examines how diet quality, specifically the distinction between healthful and unhealthful plant-based patterns, modifies cardiovascular associations. It also summarizes epidemiologic findings from major cohort studies and meta-analyses, evaluating the consistency, magnitude, and population variability of observed relationships with coronary heart disease, stroke, and CVD mortality. It integrates evidence from randomized controlled and pragmatic trials that report effects on LDL-C, blood pressure, adiposity, glycemic control, and inflammatory markers, highlighting both short- and long-term clinical relevance. The review synthesizes mechanistic insights from nutritional biochemistry, vascular biology, and gut microbiome research, incorporating translational preclinical work such as *Lactuca sativa* supplementation models that enhance understanding of lipid-lowering activity. Finally, the review assesses nutritional safety, discusses the alignment of plant-based patterns with contemporary cardiovascular prevention guidelines, and identifies key research gaps, including the need for long-term randomized endpoint trials, more ethnically diverse cohorts, and standardized dietary assessment tools. By integrating epidemiologic, clinical, and mechanistic evidence, this review seeks to provide a balanced and forward-looking evaluation of how well-designed plant-based diets can contribute to cardiovascular health promotion and disease prevention over the coming decade.

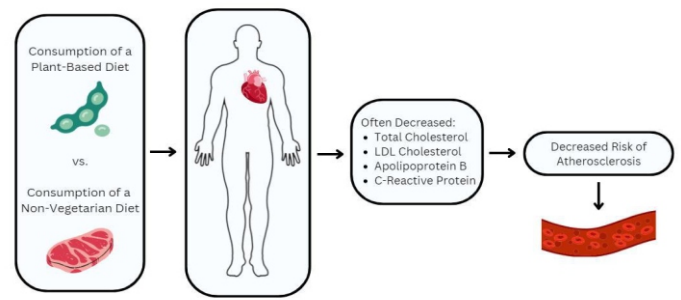


Figure 1. Plant based diet and cardiovascular health. This figure illustrates how greater adherence to a plant-based dietary pattern characterised by abundant vegetables, fruits, whole grains, legumes and nuts relates to reduced risk factors for cardiovascular disease (including lower LDL-cholesterol, blood pressure, and inflammation) and to lower incidence/mortality of CVD in population studies. It also highlights that the magnitude of benefit depends on the quality of plant foods consumed.

Source: [17].

Plant-Based Diets and Cardiovascular Health

Definition and Classification of Plant-Based Diets

A plant-based diet is most usefully defined as an eating pattern in which the majority of energy intake derives from plant-sourced foods, vegetables, fruits, legumes, whole grains, nuts, and seeds while animal-derived products are limited or absent [18]. In practice, “plant-based” covers a continuum distinguished by the degree of animal-product exclusion and by food quality (see Table 1). Common categories include: vegan (no animal products), lacto-ovo vegetarian (dairy and/or eggs permitted), pescatarian (fish/seafood included), flexitarian/semi-vegetarian (predominantly plant-based with occasional animal foods), and whole-food plant-based (WFPB) patterns that explicitly prioritize minimally processed plant foods while minimizing refined grains, added sugars, and oils [19, 20]. The Portfolio diet, an evidence-based plant-forward construct that emphasizes viscous fibers, plant protein, nuts, and phytosterols, is an example of a defined cardioprotective plant pattern [21].

Compared with typical Western omnivorous diets, healthful plant-based patterns tend to provide higher dietary fiber, complex carbohydrate, potassium, magnesium, unsaturated fatty acids and phytochemicals, alongside lower saturated fat and dietary cholesterol attributes linked to better lipid and blood-pressure control [22, 23]. Crucially, recent methodological advances have emphasized plant-food quality by distinguishing healthful versus unhealthful plant-based consumption via indices such as the healthful Plant-based Diet Index (hPDI) and unhealthful PDI (uPDI); these measures capture the differential cardiovascular implications of whole versus refined/processed plant foods [24, 25]. Table 1 summarizes classifications, typical nutrient characteristics and common research applications.

Table 1. Classification and key characteristics of common plant-based dietary patterns

Diet types	Animal products induced	Core food emphasized	Distinctive features and cardiovascular implications
Vegan	None	Fruits, vegetables, legumes, nuts, seeds, whole grains	Highest fiber and phytochemical content; markedly lowers LDL-C and blood pressure but may require B ₁₂ and calcium supplementation [26]
Lacto-Ovo Vegetarian	Dairy and eggs	Plant foods, dairy, eggs	Balanced nutrient profile with lower saturated fat than omnivorous diets; linked with reduced ischemic heart disease risk [27]
Pesco-Vegetarian	Fish and seafood	Plant foods, fish, seafood	Provides omega-3 fatty acids and plant antioxidants; improves lipid metabolism and endothelial function [28].
Flexitarian	Occasional meat	Predominantly plant foods with limited animal intake	Flexible, easier to sustain; lowers CVD and obesity risk when rich in whole grains and vegetables [29].
Whole-Food Plant-Based (WFPB)	None; excludes processed foods	Whole, minimally processed plant foods	Maximizes cardiometabolic benefits via improved lipid and inflammatory profiles [30].

Cardiovascular Health Overview

Cardiovascular disease (CVD) arises from interacting pathophysiological processes such as atherosclerotic lipid deposition, endothelial dysfunction, chronic low-grade inflammation, oxidative stress, and dysregulated blood pressure and metabolic control that operate over decades to produce clinical events [31]. Despite improvements in acute care and pharmacotherapy, the prevalence of CVD continues to rise in many regions due to aging populations, urbanization, and poor dietary habits [32]. As illustrated in Figure 2, various dietary and metabolic drivers including excessive intake of saturated fats, sugars, and imbalanced fatty acid ratios, contribute to the oxidative and inflammatory pathways underlying CVD development. Diet quality is now recognized as a key determinant of cardiovascular health. Unhealthy dietary patterns characterized by high saturated fat, sodium, and added sugars are strongly linked to dyslipidemia, hypertension, and endothelial dysfunction [33, 34]. Conversely, diets emphasizing plant-derived foods fruits, vegetables, legumes, whole grains, nuts, and seeds are consistently associated with lower incidence of coronary heart disease and stroke [35]. These protective effects are largely attributed to high intakes of fiber, antioxidants, and unsaturated fatty acids, alongside reduced consumption of pro-inflammatory animal fats and refined carbohydrates [36].

Epidemiological findings further affirm these associations. In the ARIC study, greater adherence to plant-based dietary indices was associated with a 16% lower risk of CVD and a 31% reduction in CVD mortality [37]. Similarly, a 2023 systematic review and meta-analysis involving more than 2.2 million participants found that greater adherence to plant-based dietary patterns, including vegetarian and vegan diets, was associated with a significant reduction in cardiovascular disease risk [38]. These benefits appear stronger when diets emphasize whole, minimally processed plant foods, underscoring the importance of distinguishing between “healthful” and “unhealthful” plant-based patterns [39]. Overall, dietary modification remains a cornerstone of global CVD prevention strategies. As supported by the 2021 AHA dietary guidance, plant-forward eating patterns complement other lifestyle measures such as physical activity and weight management in promoting cardiovascular resilience [40].

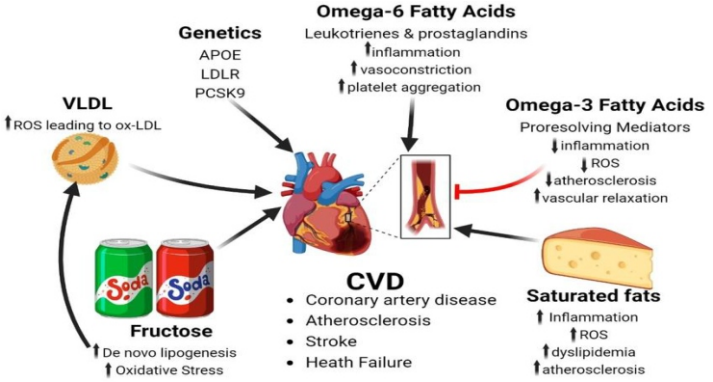


Figure 2. Dietary and other drivers in Cardiovascular Disease (CVD). This diagram illustrates key dietary, metabolic, and lifestyle drivers that contribute to cardiovascular disease, including the effects of excess saturated fat, refined sugars, and pro-inflammatory nutrients on lipid metabolism, blood pressure, and vascular health.

Source: [41].

Mechanistic Pathways Linking Healthful Plant-Based Diets to Cardiovascular Protection

Healthful plant-based diets emphasizing whole grains, fruits, vegetables, legumes, nuts, tea, coffee, and non-hydrogenated vegetable oils confer cardiovascular benefits through a constellation of interrelated molecular, metabolic, and physiological mechanisms [42, 43]. These mechanisms operate synergistically to improve lipid metabolism, endothelial function, inflammatory status, oxidative balance, and gut microbial ecology, thereby reducing atherosclerotic progression and cardiovascular disease (CVD) risk. The potential biological pathways through which healthful plant-based diets influence cardiovascular health are illustrated in Figure 3. These mechanisms encompass molecular, metabolic, and physiological processes that collectively contribute to improved cardiometabolic outcomes [44].

i. Lipid Metabolism and Energy Homeostasis

Plant-based diets influence cardiovascular and metabolic health through multiple interconnected mechanisms. Their naturally low saturated fat content and high levels of unsaturated fats,

soluble fiber, and plant sterols modulate lipid metabolism and energy homeostasis. Soluble fibers, such as β -glucans and pectins, bind bile acids in the intestine, increasing fecal cholesterol excretion and reducing hepatic cholesterol synthesis, which lowers circulating LDL-cholesterol levels [45, 46]. Replacing saturated fatty acids with polyunsaturated fatty acids further improves lipid profiles by lowering the total-to-HDL cholesterol ratio and reducing coronary heart disease risk. Saturated fats may also activate pro-inflammatory TLR4 signaling pathways and promote translocation of lipopolysaccharides (LPS) into circulation, contributing to systemic inflammation, whereas unsaturated fats activate anti-inflammatory signaling cascades [47]. Additionally, the higher fiber content and lower energy density of plant-based diets promote satiety through gastric distention and slower gastric emptying, regulate postprandial glycemia, and support long-term weight management mechanisms that indirectly reinforce cardiovascular and metabolic health.

ii. Endothelial Function and Nitric Oxide (NO) Bioavailability

A key mechanism underlying the vascular benefits of plant-based diets is enhanced endothelial function through increased nitric oxide bioavailability. Polyphenol-rich foods such as cocoa, green tea, and berries upregulate endothelial nitric oxide synthase (eNOS), leading to greater NO production and vasodilation [48]. Antioxidants like vitamins C and E, carotenoids, and polyphenols protect NO from oxidative degradation, preserving endothelial responsiveness and reducing arterial stiffness [49]. These effects contribute to lower blood pressure and improved arterial compliance [50].

iii. Inflammatory and Oxidative Stress Pathways

Plant-based diets exert strong anti-inflammatory and antioxidant effects via bioactive compounds such as flavonoids, lignans, and phenolic acids. Polyphenols modulate redox-sensitive transcription factors, notably suppressing NF- κ B activation and reducing inflammatory mediators like IL-6, TNF- α , and CRP. In parallel, they enhance the expression of endogenous antioxidant enzymes such as superoxide dismutase (SOD) and glutathione peroxidase [51], thereby reducing reactive oxygen species (ROS) burden. Additionally, PUFAs improve insulin sensitivity and modulate gene expression related to lipid and glucose metabolism, while plant antioxidants inhibit LDL oxidation, stabilize atherosclerotic plaques, and protect vascular endothelium [52]. Together, these processes form a central defense against atherogenesis through the combined suppression of inflammation and oxidative stress.

iv. Gut Microbiota and Metabolite Signaling

The gut microbiome represents an emerging link between plant-based nutrition and cardiovascular health [53]. Diets rich in fiber and polyphenols increase microbial diversity and favor the growth of short-chain fatty acid (SCFA)-producing bacteria such as *Faecalibacterium prausnitzii* and *Roseburia* spp. SCFAs including butyrate and propionate enhance lipid metabolism, improve insulin sensitivity, and exert systemic anti-inflammatory and vasodilatory effects [54]. While some evidence suggests no consistent dietary correlation with TMAO, plant-derived compounds such as resveratrol may inhibit TMA formation, thereby reducing TMAO levels [1]. Moreover, plant-based diets influence other microbe-dependent pathways, enhancing fiber and polyphenol fermentation while reducing

bile acid and amino acid metabolism [2], further contributing to their cardioprotective profile.

v. Antioxidant Micronutrients and Electrolyte Contributions

Plant-based diets are abundant in micronutrients that support vascular and metabolic health. Potassium reduces blood pressure and stroke risk through improved endothelial function and vascular relaxation [3], while magnesium improves insulin sensitivity and exerts vasodilatory, antiarrhythmic, and anti-inflammatory effects [4]. These micronutrients act synergistically with polyphenols and unsaturated fats to maintain vascular homeostasis and optimal metabolic function.

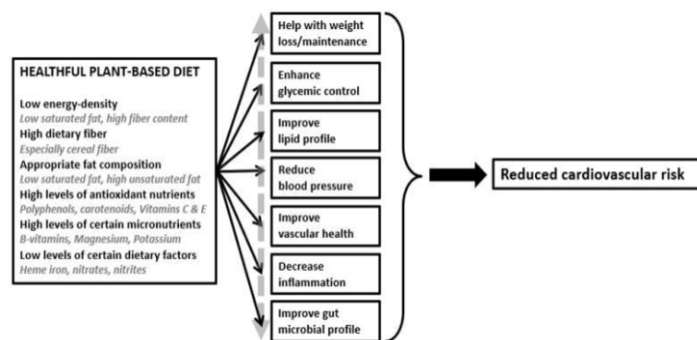


Figure 3. Potential mechanisms underlying the cardiovascular effects of healthy plant-based diets. The diagram illustrates how dietary components such as fiber, unsaturated fats, polyphenols, and micronutrients interact through metabolic, inflammatory, and microbial pathways to promote cardiovascular health.

Source: [5]

Evidence from Observational Studies on Plant-Based Diets and Cardiovascular Health

Cohort Studies

Large prospective cohorts have driven much of the evidence linking plant-based dietary patterns to cardiovascular disease (CVD) incidence and mortality. The Adventist Health Study-2 (AHS-2) has been pivotal. Their analyses indicate that higher plant protein and plant-rich dietary patterns are associated with lower cardiovascular mortality and coronary heart disease risk compared with diets high in animal protein, although associations vary by specific endpoints and appear sensitive to how plant patterns are defined [6].

European cohorts (notably EPIC) and pooled analyses have used plant-based diet indices (PDI, hPDI, uPDI) to show consistent patterning: greater adherence to healthy plant-based diets (hPDI) is associated with lower incidence of coronary heart disease and overall CVD, whereas unhealthy plant indices (uPDI), those high in refined grains, sugary drinks, and ultra-processed plant foods show null or adverse associations (dose-response results summarized in meta-analyses) [7, 8].

Cohorts from North America (Nurses' Health Study, Health Professionals Follow-Up Study, ARIC) and more contemporary large databases (UK Biobank, Million Veteran Program) similarly report inverse associations between healthy plant-forward patterns and CHD incidence as well as CVD mortality, often with effect sizes in the 10–25% relative risk reduction range for highest versus lowest adherence categories [9]. Notably, ARIC and several pooled analyses emphasize that the effect magnitude depends on plant-food quality including whole grains, legumes, nuts, and vegetables drive benefit, while processed plant foods weaken it [10].

[11] provided a synthesis that overall PDIs and hPDI are inversely associated with incident CVD and CHD in pooled cohorts, but heterogeneity across studies is moderate to high, stemming from differences in dietary assessment, outcome ascertainment, and confounder control. Some cohort results differ by geography and baseline risk (e.g., East Asian cohorts show variable associations), indicating effect modification by population dietary context and background risk.

Cross-Sectional Studies

Cross-sectional and short-term observational analyses have consistently linked plant-based patterns with favorable intermediate cardiometabolic markers. Compared with omnivorous patterns, habitual vegans/vegetarians typically have lower BMI, lower total and LDL-cholesterol, lower systolic and diastolic blood pressure, and lower markers of systemic inflammation (e.g., CRP), although HDL can be slightly lower in some vegetarian groups (and contextually this is not always adverse). These cross-sectional associations are supported by

meta-analyses of vegetarian intervention trials showing average LDL-C and blood-pressure reductions versus control diets [12, 13]. Several population cross-sectional analyses have explored plant-diet indices and metabolic syndrome components: higher hPDI scores are associated with lower waist circumference, improved insulin sensitivity, and lower prevalence of hypertension; conversely, uPDI correlates with worse lipid profiles and higher BMI. These intermediate marker associations provide biological plausibility for the cohort findings linking plant-based patterns to lower CHD and CVD events [14]. Table 2 summarizes core cohort evidence demonstrating that healthful plant-based dietary patterns rich in whole grains, fruits, vegetables, legumes, and nuts consistently predict lower incidence and mortality from coronary heart disease and overall cardiovascular disease. Effects are attenuated or reversed with unhealthful plant-based diets.

Table 2. Summary of major cohort studies evaluating plant-based diets and cardiovascular outcomes

Cohort	Population (region)	Dietary exposure	Main cardiovascular outcome(s)	Verified finding	Sources
Adventist Health Study-2	~73,000 adults, USA	Vegetarian, vegan, semi-vegetarian patterns	CVD and CHD mortality	Plant-based diets associated with lower cardiovascular mortality.	[15]
Nurses' Health Study & HPFS	>200,000 U.S. adults	hPDI, uPDI	CHD incidence	Higher hPDI linked to ↓ CHD risk; uPDI linked to ↑ risk.	[16]
EPIC-Oxford	48,188 UK adults	Vegetarian/vegan vs meat-eaters	IHD, stroke	Lower IHD but slightly higher hemorrhagic stroke risk in vegetarians.	[17]
ARIC Study	~12,000 U.S. adults	PDI, hPDI	CVD incidence and mortality	Higher plant-based scores associated with lower CVD risk.	[18]
UK Biobank	~126,000 UK adults	Plant-rich diet indices	CHD and stroke	Healthful plant-rich diets associated with lower CHD and stroke risk.	[19]

Abbreviations: CVD – Cardiovascular Disease; CHD – Coronary Heart Disease; IHD – Ischemic Heart Disease; hPDI – Healthful Plant-Based Diet Index; uPDI – Unhealthful Plant-Based Diet Index; PDI – Plant-Based Diet Index; HPFS – Health Professionals Follow-Up Study; ARIC – Atherosclerosis Risk in Communities; EPIC – European Prospective Investigation into Cancer and Nutrition.

Clinical Trial Evidence (RCTs)

A growing number of randomized controlled trials over the past decade have confirmed that plant-based dietary interventions can significantly improve lipid profiles, blood pressure, and inflammatory markers, often comparable to pharmacologic or other diet-based interventions. A 2023 randomized identical-twin trial provided strong experimental confirmation reporting that in the randomized clinical trial of 22 healthy, adult, identical twin pairs, those consuming a healthy vegan diet showed significantly improved low-density lipoprotein cholesterol concentration, fasting insulin level, and weight loss compared with twins consuming a healthy omnivorous diet thereby suggesting that a healthy plant-based diet offers a significant protective cardiometabolic advantage compared with a healthy omnivorous diet [20]. Similarly, a 16-week randomized trial led by [21] tested a low-fat vegan diet in overweight adults and found significant improvements in LDL-C, insulin sensitivity, and hepatic fat content relative to controls. These effects occurred without prescribed energy restriction, underscoring metabolic benefits intrinsic to plant-based patterns. Another RCT from [22] found that an 18-week, low-fat, plant-based diet intervention in a corporate setting led to significant improvements in body weight, cardiovascular risk factors, and glycemic control for

employees with diabetes. The intervention group experienced greater weight loss, a greater reduction in total and LDL cholesterol, and a significant decrease in HbA1c levels compared to the control group. [22] later replicated these findings in a community-based setting (the BROAD Study), confirming that real-world adoption of a whole-food plant-based diet reduced body weight, LDL cholesterol, and total cholesterol over 6–12 months without calorie counting. The evidence consistently demonstrates that plant-based interventions lower LDL-C and improve endothelial function, reduce hs-CRP and systolic blood pressure, and yield significant cardiometabolic benefits. Differences in magnitude reflect trial duration, adherence, and baseline diet. These data confirm that well-structured plant-based diets are an effective non-pharmacologic strategy for improving cardiovascular risk markers.

Public Health and Policy Implications

Shifting population dietary patterns towards diets abundant in whole plant foods presents a dual opportunity, reducing cardiovascular disease (CVD) incidence and advancing sustainable food systems. The World Health Organization (WHO) emphasises healthier diets as a cornerstone of CVD prevention and calls for policies that promote the availability and affordability of plant-rich foods [23]. Meanwhile, the American Heart Association (AHA) 2021 statement lists diets high in fruits, vegetables, whole grains, legumes, and nuts and low in processed meats and saturated fat as key to cardiovascular health [24]

Dietary Guidelines and Recommendations

Modern dietary guidance converges around plant-forward, minimally processed eating patterns as the foundation for health promotion and disease prevention. The American Heart Association (AHA) [25] emphasizes diets rich in fruits, vegetables, legumes, whole grains, and nuts, with minimal saturated fat, sodium, and added sugars, as central to CVD prevention. At the national level, the U.S. Dietary Guidelines for Americans 2020–2025 recommend flexible, culturally adaptable dietary patterns rich in plant foods that promote health across diverse populations [25]. The UK's Eatwell Guide and Canada's Food Guide both emphasize diets rich in plant-based foods. The Eatwell Guide encourages eating plenty of fruits and vegetables, choosing lean proteins, and limiting foods high in fat, salt, and sugar, while supporting guidance advises consuming less red and processed meat. Similarly, Canada's Food Guide highlights plant-based protein foods, recommends choosing water as the drink of choice, and promotes healthy eating patterns that support overall well-being (See figure 4) [26]. Despite this growing global convergence on dietary guidance, a 2022 global review found that only about 44% of national food-based dietary guidelines explicitly mention environmental sustainability, highlighting the need for broader policy coherence [26].

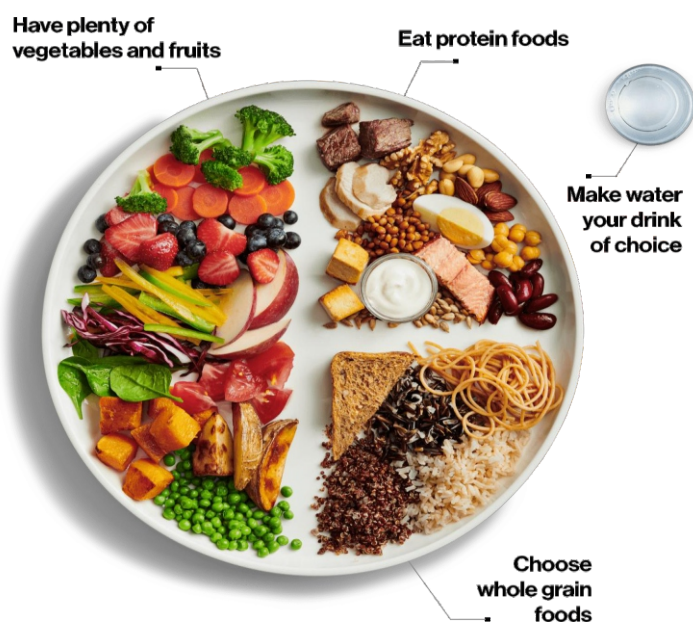


Figure 4. Canada's Food Guide Plate (2019). This diagram illustrates the recommended proportions of foods for a healthy eating pattern: half the plate should be vegetables and fruits, one-quarter whole grains, and one-quarter protein foods, with an emphasis on plant-based proteins.

Source: [27].

Sustainability and Environmental Co-benefits

Plant-based diets offer powerful co-benefits for environmental protection and climate mitigation. A global meta-analysis by [28] demonstrated that replacing animal products with plant foods can reduce greenhouse gas emissions by nearly half and agricultural land use by over 70%. The EAT–Lancet Commission proposed the “planetary health diet,” which could prevent approximately 11 million premature deaths annually while remaining within planetary boundaries [29].

Further modeling by [30] revealed that large-scale adoption of plant-rich diets could reduce global diet-related mortality by up to 30% and food-related greenhouse gas emissions by 50–70%. Additionally, life-cycle assessments confirm that legumes, grains, and vegetables require far less land, water, and fertilizer than meat and dairy, yielding significant sustainability advantages [30]. Thus, dietary reform represents a critical lever for achieving both public health resilience and climate targets.

Implementation Challenges

Translation of evidence into population impact faces substantial barriers: economic inequities, limited access to healthy foods in underserved communities, cultural preferences for meat-dominant diets, and nutrition literacy gaps. In many food-insecure settings, cheaper ultra-processed foods dominate over fresh plant foods [31]. Effective policy levers include fiscal tools (subsidies for pulses, vegetables; taxes on ultra-processed foods), revised public procurement standards (schools, hospitals), clear front-of-pack labelling, and culturally appropriate nutrition education [32]. Ensuring nutrient adequacy as populations transition is equally vital, especially for vitamin B12, iron, and iodine in plant-forward shifts [33, 34].

Methodological Limitations

Despite this encouraging evidence base, there are notable methodological limitations that temper interpretation. They include;

Dietary Exposure Assessment and Heterogeneity

One major challenge is the heterogeneity in definitions of “plant-based” diets. Some studies focus on vegetarian or vegan diets, others on plant-based diet indices (PDI, healthy PDI, unhealthy PDI) that weight plant and animal foods differently. In their 2021 review, [35] found substantial heterogeneity (e.g., $I^2 > 80\%$ in several analyses) in meta-analyses relating adherence to plant-based dietary indices to cardiovascular disease outcomes. They attribute much of this variability to differences in how plant-based diets were defined and scored across studies. The reliance on self-reported dietary intake (food frequency questionnaires) also raises concerns about misclassification and residual confounding.

Confounding and Residual Bias

Observational studies are inherently vulnerable to confounding by lifestyle and socioeconomic factors. Individuals who adopt plant-based diets may differ systematically (e.g., higher education, non-smoking status, more physical activity) from non-adherents. Some analyses attempt to adjust for these covariates, but residual confounding cannot be ruled out. Moreover, adherence bias (those able to maintain a plant-based diet might differ in other health behaviours) may exaggerate apparent benefits [36].

Limited Long-Term Interventional Evidence

While RCTs have documented favourable changes in cardiometabolic biomarkers (lipids, weight, HbA_{1c}) with vegetarian/vegan diets, there remains a paucity of large-scale, long-duration RCTs that directly assess hard cardiovascular endpoints (e.g., myocardial infarction, stroke, cardiovascular mortality) in plant-based diet interventions. Thus, the highest level of evidence (large RCTs with clinical outcomes) is still lacking [37].

Quality of Plant-Based Foods Matters

Several recent analyses underscore that “plant-based” does not automatically mean “healthy.” For example, in the meta-analysis by [38], the inverse association between plant-based dietary patterns and cardiovascular disease risk was stronger when the diet emphasised whole grains, legumes, nuts, fruits, and vegetables (a ‘healthy’ plant-based diet index). By contrast, the association was weaker (and in some studies non-significant or even positive) when the plant-based diet included higher intakes of refined grains, sugar-sweetened beverages and other less healthy plant foods (an ‘unhealthy’ plant-based diet index). This nuance is often under-emphasised in dietary patterns research.

Future Research Directions

Despite strong evidence supporting the cardiovascular benefits of plant-based diets, critical gaps remain that warrant targeted research. Large-scale, long-term randomized controlled trials are needed to directly evaluate the impact of plant-based interventions on hard cardiovascular endpoints, such as myocardial infarction, stroke, and cardiovascular mortality, beyond improvements in surrogate markers like lipid profiles and blood pressure. Standardizing definitions of plant-based diets and incorporating measures of diet quality are essential to distinguish the effects of whole, minimally processed plant foods from ultra-processed alternatives, as the cardiovascular benefits are largely contingent on food quality.

Mechanistic studies should further elucidate pathways through which plant-based diets confer cardiovascular protection, including lipid metabolism, endothelial function, systemic inflammation, oxidative stress, and gut microbiome modulation. Employing advanced approaches such as metabolomics, proteomics, and microbiome analyses can clarify causal mechanisms and interactions. Research in diverse populations across age, ethnicity, socioeconomic status, and comorbid conditions is also crucial to identify differential responses and inform personalized dietary strategies. Finally, implementation and translational research should focus on strategies to enhance adherence, accessibility, and cultural acceptability of high-quality plant-based diets, integrating behavioral, social, and policy-level interventions. Addressing these areas will provide robust, mechanistic, and population-relevant evidence to optimize cardiovascular health and facilitate the adoption of sustainable dietary practices worldwide.

Conclusion

Plant-based diets, encompassing vegetarian, vegan, and predominantly plant-focused dietary patterns, have emerged as a compelling strategy for improving cardiovascular health. Evidence from epidemiological studies, clinical trials, and mechanistic research consistently demonstrates that these diets can reduce the risk of cardiovascular disease, improve lipid profiles, lower blood pressure, modulate inflammation, and enhance overall metabolic health. The cardiovascular benefits are most pronounced when plant-based diets emphasize whole, minimally processed foods such as fruits, vegetables, legumes, whole grains, nuts, and seeds. While promising, these diets require careful planning to ensure nutritional adequacy, particularly with regard to vitamin B12, omega-3 fatty acids, iron, and other key nutrients. The growing body of evidence highlights both the clinical potential and public health relevance of plant-based diets, underscoring their role not only in individual health promotion but also in broader strategies for

sustainable nutrition. Future research should continue to refine our understanding of diet quality, long-term adherence, and population-specific effects to maximize cardiovascular benefits while supporting nutritional sufficiency and lifestyle feasibility.

Acknowledgement

We thank all the researchers who contributed to the success of this research work.

Conflict of Interest

The authors declared that there are no conflicts of interest.

Funding

No funding was received for this research work.

References

1. Aaron, K.J. and Sanders, P.W. (2013). Role of Dietary Salt and Potassium Intake in Cardiovascular Health and Disease: A Review of the Evidence. *Mayo Clin Proc.* 2013;88(9):987–95. doi: 10.1016/j.mayocp.06.005.
2. Aburto, N.J., Hanson, S., Gutierrez, H., Hooper, L., Elliott, P. and Cappuccio, F.P. (2013). Effect of increased potassium intake on cardiovascular risk factors and disease: systematic review and meta-analyses. *BMJ.* 346:f1378. doi: 10.1136/bmj.f1378.
3. Ayo, V. I., Adondua, M. A., Morayo, A. E., Ekele, J., Amilo, D., Ochuele, D. A., Ayantse, L. M., Barrah, C., Abdulsalam, I. O., Eya, S. B., Iheanacho, C. C., Tibile, S. T., Mohammed, R. I. and Barde, C. E. (2023). Effect of *Lactuca sativa*–supplemented diet on Poloxamer 407–induced hyperlipidemic albino rats (*Rattus norvegicus*). *Asian Journal of Natural Product Biochemistry.* 21; 67–78. <https://doi.org/10.13057/biofar/f210203>
4. Bruns, A., Greupner, T., Nebl, J. and Hahn, A. (2024). Plant-based diets and cardiovascular risk factors: a comparison of flexitarians, vegans and omnivores in a cross-sectional study. *BMC nutrition.* 10(1); 29. <https://doi.org/10.1186/s40795-024-00839-9>
5. Butcko, A. J., Putman, A. and Mottillo, E. P. (2024). The Intersection of Genetic Factors, Aberrant Nutrient Metabolism and Oxidative Stress in the Progression of Cardiometabolic Disease. *Antioxidants.* 13(1):87. DOI:10.3390/antiox13010087
6. Chen, M.L., Yi, L., Zhang, Y., Zhou, X., Ran, L., Yang, J., *et al.* (2016). Resveratrol Attenuates Trimethylamine-N-Oxide (TMAO)-Induced Atherosclerosis by Regulating TMAO Synthesis and Bile Acid Metabolism via Remodeling of the Gut Microbiota. *mBio.* 7(2):e02210–15. doi: 10.1128/mBio.02210-15.
7. De Filippis, F., Vitaglione, P., Cuomo, R., Berni Canani, R. and Ercolini, D. (2018). Dietary Interventions to Modulate the Gut Microbiome-How Far Away Are We From Precision Medicine. *Inflammatory bowel diseases.* 24(10); 2142–2154. <https://doi.org/10.1093/ibd/izy080>
8. De Filippo, C., Cavalieri, D., Di Paola, M., Ramazzotti, M., Poullet, J.B., Massart, S., *et al.* (2010). Impact of diet in shaping gut microbiota revealed by a comparative study in children from Europe and rural Africa. *Proc Natl Acad Sci U S A.* 107(33):14691–6. doi: 10.1073/pnas.1005963107.
9. Elliott, P. S., Kharaty, S. S. and Phillips, C. M. (2022). Plant-based diets and lipid, lipoprotein, and inflammatory biomarkers of cardiovascular disease: A review of observational and interventional studies. *Nutrients.* 14(24); 5371. <https://doi.org/10.3390/nu14245371>
10. Fritsche, K.L. (2015). The Science of Fatty Acids and Inflammation. *Advances in Nutrition: An International Review Journal.* 6(3):293S–301S. doi: 10.3945/an.114.006940.

11. Gan, H. Z., Cheong, C., Tu, Y. and Kuo, P. (2021). Association between Plant-Based Dietary Patterns and Risk of Cardiovascular Disease: A Systematic Review and Meta-Analysis of Prospective Cohort Studies. *Nutrients*. 13(11); 3952. <https://doi.org/10.3390/nu13113952>
12. Glick-Bauer, M. and Yeh, M.C. (2014). The health advantage of a vegan diet: Exploring the gut microbiota connection. *Nutrients*. 6(11):4822–38. doi:10.3390/nu6114822.
13. Grosso, G., Godos, J., Currenti, W., Micek, A., Falzone, L., Libra, M., Giampieri, F., Forbes-Hernández, T. Y., Quiles, J. L., Battino, M., La Vignera, S. and Galvano, F. (2022). The Effect of Dietary Polyphenols on Vascular Health and Hypertension: Current Evidence and Mechanisms of Action. *Nutrients*. 14(3); 545. <https://doi.org/10.3390/nu14030545>
14. Health Canada. (2019). Canada's Food Guide. Government of Canada. <https://food-guide.canada.ca/en/>
15. Hemler, E. C. and Hu, F. B. (2019). Plant-based diets for personal, population, and planetary health. *Advances in Nutrition*. 10(4); S275–S283. <https://doi.org/10.1093/advances/nmy117>
16. James-Martin, G., Baird, D. L., Hendrie, G. A., Bogard, J., Anastasiou, K., Brooker, P. G., Wiggins, B., Williams, G., Herrero, M., Lawrence, M., Lee, A. J. and Riley, M. D. (2022). Environmental sustainability in national food-based dietary guidelines: a global review. *The Lancet. Planetary health*. 6(12); e977–e986. [https://doi.org/10.1016/S2542-5196\(22\)00246-7](https://doi.org/10.1016/S2542-5196(22)00246-7)
17. Jarvis, S. E., Nguyen, M. and Malik, V. S. (2022). Association between adherence to plant-based dietary patterns and obesity risk: a systematic review of prospective cohort studies. *Applied Physiology, Nutrition, and Metabolism*. <https://doi.org/10.1139/apnm-2022-0059>
18. Jenkins, D. J., Jones, P. J., Lamarche, B., Kendall, C. W., Faulkner, D., Cermakova, L., Giguere, I., Ramprasath, V., de Souza, R., Ireland, C., Patel, D., Srichaikul, K., Abdunour, S., Bashyam, B., Collier, C., Hoshizaki, S., Josse, R. G., Leiter, L. A., Connelly, P. W. and Frohlich, J. (2011). Effect of a dietary portfolio of cholesterol-lowering foods given at 2 levels of intensity of dietary advice on serum lipids in hyperlipidemia: a randomized controlled trial. *JAMA*. 306(8); 831–839. <https://doi.org/10.1001/jama.2011.1202>
19. Kahleova, H., Levin, S. and Barnard, N. D. (2018). Vegetarian Dietary Patterns and Cardiovascular Disease. *Progress in cardiovascular diseases*. 61(1); 54–61. <https://doi.org/10.1016/j.pcad.2018.05.002>
20. Kent, G., Kehoe, L., Flynn, A. and Walton, J. (2022). Plant-based diets: a review of the definitions and nutritional role in the adult diet. *The Proceedings of the Nutrition Society*. 81(1), 62–74. <https://doi.org/10.1017/S0029665121003839>
21. Kim, H., Caulfield, L. E., Garcia-Larsen, V., Steffen, L. M., Coresh, J. and Rebholz, C. M. (2019). Plant-Based Diets Are Associated With a Lower Risk of Incident Cardiovascular Disease, Cardiovascular Disease Mortality, and All-Cause Mortality in a General Population of Middle-Aged Adults. *Journal of the American Heart Association*. 8(16); e012865. <https://doi.org/10.1161/JAHA.119.012865>
22. Kim, H., Caulfield, L. E., Garcia-Larsen, V., Steffen, L. M., Coresh, J. and Rebholz, C. M. (2019). Plant-Based Diets Are Associated With a Lower Risk of Incident Cardiovascular Disease, Cardiovascular Disease Mortality, and All-Cause Mortality in a General Population of Middle-Aged Adults. *Journal of the American Heart Association*. 8(16); e012865. <https://doi.org/10.1161/JAHA.119.012865>
23. Koeder, C., Alzughayyar, D., Anand, C., Kranz, R. M., Husain, S., Schoch, N., Hahn, A. and Englert, H. (2022). The healthful plant-based diet index as a tool for obesity prevention-The healthy lifestyle community program cohort 3 study. *Obesity science & practice*. 9(3); 296–304. <https://doi.org/10.1002/osp4.649>
24. Kolte, D., Vijayaraghavan, K., Khera, S., Sica, D.A. and Frishman, W.H. (2014). Role of magnesium in cardiovascular diseases. *Cardiol Rev*. 22(4):182–92. doi:10.1097/CRD.0000000000000003.
25. Landry, M. J., Ward, C. P., Cunanan, K. M., et al. (2023). Cardiometabolic effects of omnivorous vs vegan diets in identical twins: A randomized clinical trial. *JAMA Network Open*. 6(11); e2344457. <https://doi.org/10.1001/jamanetworkopen.2023.44457>
26. Lichtenstein, A. H., Appel, L. J., Vadiveloo, M., Hu, F. B., Kris-Etherton, P. M., Rebholz, C. M., ... Van Horn, L. (2021). 2021 dietary guidance to improve cardiovascular health: A scientific statement from the American Heart Association. *Circulation*. 144(23); e472–e487. <https://doi.org/10.1161/CIR.0000000000001031>
27. Mensah, G. A., Fuster, V., Murray, C. J. L., Roth, G. A. and Global Burden of Cardiovascular Diseases and Risks Collaborators (2023). Global Burden of Cardiovascular Diseases and Risks, 1990–2022. *Journal of the American College of Cardiology*. 82(25); 2350–2473. <https://doi.org/10.1016/j.jacc.2023.11.007>
28. Mishra, S., Xu, J., Agarwal, U., Gonzales, J., Levin, S. and Barnard, N. D. (2013). A multicenter randomized controlled trial of a plant-based nutrition program to reduce body weight and cardiovascular risk in the corporate setting: the GEICO study. *European journal of clinical nutrition*. 67(7); 718–724. <https://doi.org/10.1038/ejcn.2013.92>
29. Poore, J. and Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science*. 360; 987–992. DOI:10.1126/science.aag0216
30. Popkin, B. M. (2017). Relationship between shifts in food system dynamics and acceleration of the global nutrition transition. *Nutrition reviews*. 75(2); 73–82. <https://doi.org/10.1093/nutrit/nuw064>
31. Public Health England. (2016). The Eatwell Guide. Crown Copyright. https://assets.publishing.service.gov.uk/media/5bbb790de5274a22415d7fee/Eatwell_guide_colour_edition.pdf
32. Quek, J., Lim, G., Lim, W. H., Ng, C. H., So, W. Z., Toh, J., Pan, X. H., Chin, Y. H., Muthiah, M. D., Chan, S. P., Foo, R. S. Y., Yip, J., Neelakantan, N., Chong, M. F. F., Loh, P. H. and Chew, N. W. S. (2021). The Association of Plant-Based Diet With Cardiovascular Disease and Mortality: A Meta-Analysis and Systematic Review of Prospect Cohort Studies. *Frontiers in cardiovascular medicine*. 8; 756810. <https://doi.org/10.3389/fcvm.2021.756810>
33. Quiñones, M., Miguel, M. and Aleixandre A. (2013). Beneficial effects of polyphenols on cardiovascular disease. *Pharmacol Res*. 68(1):125–31. doi:10.1016/j.phrs.2012.10.018.
34. Satija, A. and Hu, F. B. (2018). Plant-based diets and cardiovascular health. *Trends in cardiovascular medicine*. 28(7); 437–441. <https://doi.org/10.1016/j.tcm.2018.02.004>
35. Satija, A., Bhupathiraju, S. N., Spiegelman, D., Chiuve, S. E., Manson, J. E., Willett, W. C. and Hu, F. B. (2017). Healthful and unhealthful plant-based diets and the risk of coronary heart disease in U.S. adults. *Journal of the American College of Cardiology*. 70(4); 411–422. <https://doi.org/10.1016/j.jacc.2017.05.047>
36. Smith, C.E. and Tucker, K.L. (2011). Health benefits of cereal fibre: a review of clinical trials. *Nutr Res Rev*. 24(1):118–31. doi:10.1017/S0954422411000023.
37. Springmann, M., Wiebe, K., Mason-D'Croz, D., Sulser, T. B., Rayner, M. and Scarborough, P. (2018). Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: a global modelling analysis with country-level detail. *The Lancet. Planetary health*. 2(10); e451–e461. [https://doi.org/10.1016/S2542-5196\(18\)30206-7](https://doi.org/10.1016/S2542-5196(18)30206-7)

38. Tangney, C. and Rasmussen, H.E. (2013). Polyphenols, Inflammation, and Cardiovascular Disease. *Current atherosclerosis reports*. 15(5):324. doi: 10.1007/s11883-013-0324-x.
39. Tharrey, M., Mariotti, F., Mashchak, A., Barbillon, P., Delattre, M. and Fraser, G. E. (2018). Patterns of plant and animal protein intake are strongly associated with cardiovascular mortality: the Adventist Health Study-2 cohort. *International journal of epidemiology*. 47(5); 1603–1612. <https://doi.org/10.1093/ije/dyy030>
40. Thompson, A.S., Tresserra-Rimbau, A., Karavasiloglou, N., *et al.* (2023). Association of Healthful Plant-based Diet Adherence With Risk of Mortality and Major Chronic Diseases Among Adults in the UK. *JAMA Netw Open*. 6(3):e234714. doi:10.1001/jamanetworkopen.2023.4714
41. Tomé-Carneiro, J. and Visioli, F. (2023). Plant-based diets reduce blood pressure: A systematic review of recent evidence. *Current Hypertension Reports*. 25; 127. <https://doi.org/10.1007/s11906-023-01243-7>
42. Tong, T. *et al.* (2019). Risks of ischaemic heart disease and stroke in meat eaters, fish eaters, and vegetarians over 18 years of follow-up: results from the prospective EPIC-Oxford study. *BMJ*. 366. doi: <https://doi.org/10.1136/bmj.l4897>
43. U.S. Department of Agriculture and U.S. Department of Health and Human Services. (2020). *Dietary Guidelines for Americans, 2020–2025* (9th ed.). U.S. Government Publishing Office. <https://www.dietaryguidelines.gov>
44. Wang, Y., Liu, B., Han, H. *et al.* (2023). Associations between plant-based dietary patterns and risks of type 2 diabetes, cardiovascular disease, cancer, and mortality – a systematic review and meta-analysis. *Nutr. J.* 22; 46. <https://doi.org/10.1186/s12937-023-00877-2>
45. Willett, W., *et al.* (2019). Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems. *Lancet*. 393(10170); 447–492. [https://doi.org/10.1016/S0140-6736\(18\)31788-4](https://doi.org/10.1016/S0140-6736(18)31788-4)
46. Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., ... Murray, C. J. L. (2019). Food in the Anthropocene: The EAT-Lancet Commission on healthy diets from sustainable food systems. *The Lancet*. 393(10170); 447-492. [https://doi.org/10.1016/S0140-6736\(18\)31788-4](https://doi.org/10.1016/S0140-6736(18)31788-4)
47. World Health Organization (2013). Global action plan for the prevention and control of noncommunicable diseases 2013-2020. World Health Organization. <https://iris.who.int/handle/10665/94384>
48. World Health Organization. (2023). Cardiovascular diseases (CVDs) fact sheet. [https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-\(cvds\)](https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds))
49. Wright, N., Wilson, L., Smith, M. *et al.* (2017). The BROAD study: A randomised controlled trial using a whole food plant-based diet in the community for obesity, ischaemic heart disease or diabetes. *Nutr & Diabetes*. 7; e256. <https://doi.org/10.1038/nutd.2017.3>
50. Anih, D.C., A.K. Arowora, M.A. Abah and K.C. Ugwuoke, 2025. Biochemically active metabolites of gutbacteria: Their influence on host metabolism, neurotransmission, and immunity. *Sci. Int.*, 13: 46-57.36.
51. Anih, D.C., A.K. Arowora, M.A. Abah and K.C. Ugwuoke, 2025. Biochemical effects of microplastics on human health: A comprehensive review. *Sci. Int.*, 13: 27-34.37.
52. Anih, D.C., K.A. Arowora, K.C. Ugwuoke, M.A. Abah and B. Habibu, 2025. Nutritional modulation of epigenetic changes induced by mycotoxins: A biochemical perspective for at-risk populations in Africa. *Sci. Int.*, 13: 90-109.38.
53. Chinonso, A.D., A.A. Kayode, M.A. Adondua and U.K. Chinekwu, 2025. Biochemistry of traditional herbal compounds and their molecular targets. *Pharmacogn. Rev.*, 19: 83-90.39.
54. Anih, D.C., O.E. Yakubu, A.K. Arowora, M.A. Abah and U.K. Chinekwu, 2025. Biochemical mechanisms of sleep regulation. *Sci. Int.*, 13: 35-45