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Review

More than a Dietary Choice: A Multidimensional Perspective on Vegetarianism in the Current and Future Landscape

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Abstract

This review examines the environmental transition of contemporary diets, the effects of plant-based diets on human health, and vegetarianism as a phenomenon extending beyond a dietary choice, offering insights into its relationship with quality of life, physiological mechanisms, psychosocial determinants, and structural implications. In the current landscape, growing interest in vegetarianism is driven by three main factors: its contribution to multiple domains of health, its substantial potential to reduce resource use and environmental impacts, and its association with ethical and animal-related considerations. However, further research is needed to consolidate its role as a key component of future development, requiring integrated educational, cultural, technological, and policy approaches that ensure equitable access to plant-based foods, foster critical reflection on animal welfare and moral responsibility, as well as support coordinated transformations of food systems toward healthier and more environmentally sustainable societies. Ultimately, the global implementation of dietary shifts toward plant-based patterns remains anticipated but constrained, as ingrained economic and cultural interests continue to delay this pivotal systemic change. Therefore, until policy authorities enact substantial structural reforms and individuals actively promote this transition within their immediate social environments, the issue is likely to persist as a subject of ongoing debate and resistance against its operationalization.

Keywords: vegetarianism; vegetarian diets; vegan diets; human health; sustainability; animal welfare; ethical considerations; psychosocial insights

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1. Introduction

In 2012, the Food and Agriculture Organization (FAO) emphasized that considerations of dietary sustainability, in addition to nutritional value, are completely essential [1]. From the perspective of health and sustainability, an optimal diet can be defined as a dietary pattern that (i) minimizes environmental impact, safeguarding biodiversity and respecting ecosystems; (ii) ensures food and nutrition security; and (iii) fosters the health of both current and future populations. Accordingly, dietary habits represent a pivotal intervention for simultaneously promoting human health and protecting the environment. Despite this potential, prevailing food consumption patterns continue to undermine the health and welfare of human and nonhuman animals, as well as planetary stability [2–4]. In fact, if these patterns persist, they will sustain diet-related diseases and environmental pressures, including greenhouse gas emissions (GHGEs), freshwater depletion, overexploitation of land, and loss of biodiversity [4,5].

1.1. Toward a Food System Transformation

According to the Intergovernmental Panel on Climate Change (IPCC), the observed global warming is unequivocally driven by human activities, primarily through GHGEs from fossil fuel combustion, industrial processes, land-use changes, and unsustainable production and consumption patterns, leading to widespread and accelerating impacts on terrestrial, freshwater, coastal, and marine ecosystems, increased intensity and frequency of extreme weather events, disruptions to food and water security, negative consequences for human health and livelihoods, and burdens on urban infrastructure [6]. Among these human-driven pressures, current global food systems play a major role by contributing to both environmental degradation and health challenges. As noted by the European Commission's Food 2030 strategic report, transforming food systems is essential to support healthier and more sustainable diets, as well as to secure comprehensive food and nutrition outcomes, which ultimately requires a detailed understanding of the components and interactions within existing food systems to maximize co-benefits [7]. Given these circumstances, a range of strategies has been proposed to mitigate the environmental and health impacts of prevailing dietary patterns, such as the promotion of sustainable and healthy diets, the execution of policy initiatives aimed at transforming food systems, the development of alternative plant-based proteins, the sustainable management of fisheries and aquaculture, or the implementation of resource-efficient circular food systems that reduce food loss and waste [3]. However, current efforts to address environmental pressures face significant challenges, including risks of maladaptation, insufficient financial resources, fragmented or uneven implementation across regions, and inadequate policy coverage [6]. In this context, the limited availability of expertise and practical tools for implementing novel food system transformation methodologies remains a major barrier to their effective application [3]. Furthermore, although global social awareness appears to be gradually improving in support of this critical transition, it still does not seem to have reached a sufficient and widespread level to overcome practical and cultural barriers that prevent younger generations from internalizing the values necessary for a lasting commitment to sustainable dietary and environmental practices [8].

1.2. Conceptualizing Plant-Based Diets

Plant-based dietary patterns encompass a broad spectrum of eating habits characterized by a predominant intake of foods originating from plant sources and a reduced or complete avoidance of animal-derived products [9]. Within this framework, vegetarian diets represent a specific category that varies according to the degree of exclusion of animal foods: (i) lacto-vegetarian diets include the consumption of dairy products while excluding meat, fish, and eggs; (ii) ovo-vegetarian diets allow eggs but avoid dairy products, meat, and fish; and (iii) lacto-ovo-vegetarian diets include both dairy products and eggs but exclude meat and fish. There are additional plant-based dietary variants frequently classified as vegetarian diets. However, such categorization is inaccurate, as these patterns are more appropriately considered flexible plant-based diets characterized by comparatively limited restrictions on the consumption of animal-derived foods, including the following: (i) pescatarian diets, which incorporate fish along with dairy products and eggs; and (ii) flexitarian or semi-vegetarian diets, which are primarily plant-based but occasionally include dairy, eggs, meat, and fish. These latter dietary variants are closely aligned with dietary models such as the Mediterranean diet and the Nordic diet, both of which (i) are based on the consumption of typical local and seasonal foods; (ii) share nutritional recommendations grounded in plant-based dietary principles; and (iii) have increasingly incorporated concepts related to environmental protection and sustainability. Despite their substantial similarities, the principal distinction between these two diets lies in their

predominant source of dietary fat, with olive oil representing the hallmark lipid source in the Mediterranean diet, whereas rapeseed or canola oil occupies this role within the Nordic diet [10]. In turn, vegan diets represent the most rigorous and paradigmatic expression of plant-based nutrition, constituting the dietary model most consistently aligned with the complete exclusion of animal-derived foods and the fundamental principles underlying plant-based eating patterns. Indeed, vegan diets exclude all animal-derived products, including meat, fish, dairy, eggs, edible insects, and even honey.

Overall, dietary patterns centered on plant-derived foods and characterized by low intakes of salt, saturated fats, and added sugars are widely recognized as key components of a healthy lifestyle [9]. These diets have been associated with a reduced risk of premature mortality and a lower incidence of non-communicable diseases, particularly when accompanied by limited consumption of red and processed meats. Nevertheless, highly restrictive plant-based regimens, especially vegan diets, may increase the risk of inadequate intake of essential micronutrients, including iron and vitamin B12, thereby requiring careful nutritional planning [9]. In addition, evidence indicates that plant-based dietary patterns may contribute substantially to environmental sustainability [11–13]. Consequently, adherence to these dietary patterns has progressively increased in recent years, with this dietary transition commonly driven by animal welfare, ethical, religious, economic, health-related, and environmental considerations [11]. Moreover, the avoidance of animal-derived foods may also stem from a growing distrust toward animal-based products, which has increasingly shaped contemporary consumer food choices [12].

1.3. Environmental and Health Implications of Dietary Patterns

Research suggests that the lowest diet-related GHGEs can be achieved by replacing animal-source foods with plant-based alternatives or minimally processed whole foods [14,15]. Accordingly, several recent reviews emphasize that plant-based diets are more environmentally sustainable than typical omnivorous patterns, as they offer the greatest potential for reducing global water use, land occupation, biodiversity loss, and GHGEs [16–19]. In this context, Chai et al. [18] highlight that vegan diets (i.e., based uniquely on plant products) have the lowest environmental impact, while also emphasizing the importance of prioritizing local products to reduce transportation-related emissions. Additional evidence indicates that GHGEs resulting from vegan and vegetarian diets are approximately 50% and 35% lower, respectively, than those associated with conventional omnivorous dietary patterns, while also requiring fewer natural resources [20]. Conversely, Western diets (i.e., characterized by high consumption of animal products and processed foods) are associated with highly negative environmental impacts and severe animal suffering [21]. Thus, the environmental consequences of dietary choices at the population level are profound, as individual food consumption patterns directly shape the types and volumes of foods produced, thereby influencing environmental outcomes. Nevertheless, it should be noted that reported environmental impacts may vary substantially across regions due to methodological differences in dietary assessment and food classification systems [22]. While the widespread and progressive adoption of Western-style diets could accelerate ecological degradation and increase concerns over animal rights, greater adoption of plant-based diets could promote environmental sustainability and improve animal welfare. Based on these considerations, the challenge of modifying deeply ingrained eating habits represents a significant issue involving both individual responsibility and systemic regulation, including public policies, educational programs, and shifts in social norms.

The definition of a healthy diet continues to evolve as ongoing research improves understanding of how foods, nutrients, and other dietary components influence human well-being [23]. Although the global food system could potentially meet global nutritional

requirements, prevailing dietary patterns may be contributing to widespread malnutrition. For instance, food insecurity has worsened in recent years across various regions, such as sub-Saharan Africa and South America, where factors including droughts, rising food prices, economic slowdown, declining export revenues, and rapid population growth have contributed to a substantial increase in the prevalence and total number of undernourished individuals [24]. In this respect, it is plausible that a greater shift toward sustainable plant-based dietary patterns in developed regions could reduce pressure on global food and environmental resources, potentially contributing to more equitable food distribution and improved nutritional health outcomes in the world's most vulnerable populations. In addition, this issue is increasingly associated with global food systems characterized by the widespread availability, affordability, and marketing of processed and energy-dense foods, thereby promoting passive overconsumption and rising obesity rates, particularly in high-income populations [25]. Indeed, rising incomes and urbanization seem to be driving a global shift toward diets rich in refined sugars, fats, oils, and meats, thereby increasing the prevalence of type 2 diabetes (T2D), coronary heart disease, and other chronic non-communicable diseases that negatively affect life expectancy [26]. In turn, micronutrient deficiencies remain highly prevalent across both developing and developed countries, contributing to specific deficiency-related conditions and also to increased morbidity, mortality, and vulnerability to infectious (e.g., HIV/AIDS, tuberculosis) and chronic (e.g., osteoporosis, colorectal cancer) diseases [27]. However, the nature of these nutritional deficiencies might vary across regions, ranging from insufficient dietary intake to unbalanced consumption patterns. Current evidence indicates that plant-based dietary patterns, particularly vegetarian and vegan diets, may help reduce the risk of cardiovascular disease, diabetes, hypertension, dyslipidemia, dementia, and certain types of cancers, while also contributing to improvements in body weight, blood pressure, glycosylated hemoglobin, low-density lipoprotein cholesterol levels (LDL-C), and longevity [23,28,29]. Consistently, additional research suggests that diets rich in fruits, vegetables, fiber, complex carbohydrates, micronutrients, and antioxidants may help counteract metabolic disorders, inflammation, and cancer development, while also supporting gut microbiome (GM) balance, mitochondrial function, immune response, and mental health [30]. Although these insights highlight the potential of vegetarian and vegan diets for human health in high-income settings, uncertainties persist regarding their definitive implementation, especially the extent of political commitment required to establish meat-free diets as a social norm [20].

1.4. Aim of the Review

To address the diet–environment–health trilemma (i.e., the interconnected challenge of balancing dietary patterns, environmental sustainability, and human health) [20,26], it is imperative that public strategies promote healthier and more sustainable food environments through measures such as improving access to nutritious foods, reducing ultra-processed food consumption, regulating unhealthy food marketing, and incorporating environmental sustainability into dietary and agricultural policies [31]. Nevertheless, the effective development and implementation of such strategies require continuous research efforts to support informed decision-making and evidence-based policy design. Although several literature reviews provide valuable insights into sustainability and health within the diet–environment–health trilemma, the complexity of the topic still demands further inquiry, particularly regarding the promising role that plant-based foods could play in facilitating a transition toward optimal dietary patterns. To contribute to this relevant area of research and provide an integrative perspective on the multiple dimensions of vegetarianism, the present review examines: (i) the environmental transition of contemporary diets; (ii) plant-based diets and human health outcomes, with a particular focus on vegetarian

diets across a range of health-related conditions; and (iii) vegetarianism as a phenomenon extending beyond a dietary choice, offering insights into its relationship with quality of life, physiological mechanisms, psychosocial determinants, and structural implications. Importantly, a central aim of this review is to identify several future directions regarding the role of vegetarianism in contemporary societies, outlining key themes, highlighting knowledge gaps, raising critical questions, and proposing potential pathways for research, policy, and practice.

2. Method

A non-systematic, narrative approach was adopted to synthesize the evidence on vegetarianism as a potentially sustainable, health-promoting dietary pattern. Due to the multidimensional nature of vegetarianism as a phenomenon and the objective of integrating evidence across multiple fields, a narrative review was deemed the most appropriate methodology to incorporate diverse bodies of knowledge and heterogeneous study designs. This approach was considered preferable to scoping or systematic review methodologies, which are generally designed for narrowly defined research questions. Between March and May 2026, literature searches were conducted in PubMed, ResearchGate, Scopus, and Web of Science databases using multiple combinations of keywords related to the topic under investigation. These keywords included terms related to a range of domains, such as dietary patterns (e.g., vegetarian diet, vegan diet, plant-based diet), health outcomes (e.g., mental health, chronic diseases, nutrient deficiency), environmental aspects (e.g., sustainability, greenhouse gas emissions, food systems), and psychosocial factors (e.g., social identity, stigma, attitudes). In addition, reference lists of previously identified relevant articles were screened to identify further eligible studies. The selection process consisted of two main stages. First, records were screened by title and abstract, with duplicates and irrelevant studies excluded. Second, full-text articles were assessed for eligibility, and those not meeting the established criteria were removed. Study selection was not intended to provide an exhaustive identification of all available evidence. The decision to include individual studies was not based on journal characteristics or publication metrics. Instead, articles were prioritized according to their alignment with the objectives and thematic scope of the review. During the selection process, potential disagreements regarding the relevance of individual studies were resolved through discussion and consensus among the authors. Inclusion criteria comprised studies addressing plant-based dietary patterns in relation to health outcomes, sustainability, or psychosocial dimensions, as well as studies examining prevailing dietary patterns (e.g., Western diets) when providing relevant insights. Exclusion criteria included studies focused on highly specific therapeutic diets (e.g., ketogenic diets), investigations centered on isolated plant- or animal-derived compounds rather than dietary patterns, and research on psychotropic plant substances. Moreover, conference abstracts and theses were also excluded. No restrictions regarding publication date or geographical context were established. Data extracted from the selected studies were organized into thematic categories, with particular emphasis on developing a critical synthesis of the literature to provide an integrated perspective on current knowledge and future directions. Given the descriptive nature of this review, no formal quality appraisal of the included studies was performed, and no quantitative synthesis procedures were applied.

3. The Environmental Transition of Contemporary Diets

Planetary health is increasingly threatened by climate change, biodiversity loss, freshwater depletion, and other environmental disruptions, which constitute challenges that have been intensified by rapid population growth and rising demands on global food systems [12]. In this context, plant-based dietary patterns may play a pivotal role, as they

are generally considered more sustainable, largely due to their lower GHGEs and reduced environmental burden compared with animal-based diets. Moreover, greater adherence to sustainable dietary models has been associated with enhanced environmental awareness, highlighting the importance of nutritional education and public policies aimed at promoting more sustainable food choices. Nevertheless, important variability exists among specific foods and economic accessibility remains a significant limitation for lower-income populations [12].

A substantial body of evidence has identified a gradual increase in environmental sustainability across dietary patterns, with the environmental burden generally decreasing as dietary habits shift from omnivorous regimens to lacto-ovo vegetarian diets and subsequently to vegan diets, although water consumption may represent an exception in vegan dietary models. This pattern has been consistently reported in several studies based on modeled dietary scenarios and on real-world dietary practices [26,32–43], suggesting a strong agreement between predictive modeling approaches and observational evidence derived from self-selected diets. Nevertheless, the environmental impact of plant-based diets is highly dependent on the specific foods consumed within each dietary pattern. In this respect, previous research has emphasized that sustainability assessments should focus on actual individual food intake rather than theoretical or average dietary profiles, particularly given the considerable inter-individual variability that characterizes plant-based dietary behaviors [37].

Recent research has provided robust evidence supporting the association between lower consumption of animal-derived foods and reduced environmental impact. Scarborough et al. [44] combined dietary information from more than 55,000 individuals, including vegans, vegetarians, fish-eaters, and meat-eaters, with extensive food-level environmental data obtained from life-cycle assessments encompassing thousands of farms across numerous countries. Their findings demonstrated a clear positive relationship between the intake of animal-based foods and key environmental indicators, including GHGEs, land use, water consumption, eutrophication potential, and biodiversity loss. Within this framework, vegan diets consistently showed the lowest environmental burden across all evaluated parameters when compared with diets characterized by high meat consumption. Comparable results were reported in the French NutriNet-Santé cohort [45], in which vegan dietary patterns were associated with the lowest environmental impact, whereas omnivorous dietary patterns exhibit, by far, the highest level of environmental impact. Notably, the relative differences between vegan and meat-based diets regarding GHGEs and land use were highly consistent across both investigations.

Nevertheless, the environmental benefits commonly associated with plant-based dietary patterns may not be consistently observed across all dietary scenarios. Research has suggested that the sustainability benefits of reducing meat consumption may be substantially diminished depending on the specific foods used as replacements. For instance, substituting high-impact meats such as beef or lamb with large amounts of dairy products, including cheese or butter, may considerably reduce the expected environmental gains [35]. Similarly, replacing animal products with foods requiring intensive agricultural inputs, such as greenhouse-grown vegetables or out-of-season fruits transported over long distances, may offset potential reductions in GHGEs [46]. Furthermore, evidence suggests that the water demand associated with obtaining equivalent caloric intake from certain plant foods, particularly nuts, fruits, and vegetables, can in some cases exceed that required for several animal-derived foods [47,48]. Consequently, the environmental footprint of plant-based diets may vary substantially according to food selection. Although plant-based dietary patterns undoubtedly possess considerable potential to promote environmental sustainability, the extent of these benefits depends largely on the characteristics of the

foods selected and the sustainability of their production systems. Achieving meaningful environmental improvements requires substantially reducing the consumption of animal-derived foods and also prioritizing minimally processed, locally sourced, seasonal, and resource-efficient plant foods produced through sustainable agricultural practices. In this context, sustainability should be understood as a concept that integrates GHGEs, land and water use, biodiversity preservation, food accessibility, and nutritional adequacy. Therefore, the transition toward more plant-centered dietary models must be accompanied by comprehensive food system strategies aimed at optimizing agricultural production, reducing food waste, improving supply chain efficiency, and ensuring that environmentally sustainable dietary recommendations remain nutritionally balanced, economically accessible, and culturally feasible for the population. However, the prevailing tendency to evaluate food sustainability primarily through environmental indicators, while potentially overlooking the structural dynamics of contemporary food systems, requires attention. The sustainability of plant-based dietary patterns cannot be fully assessed based uniquely on theoretical environmental approaches, as large-scale transitions toward plant-centered diets may exacerbate underlying systemic challenges, including reliance on highly industrialized production chains and increasing market concentration within the global food industry. In turn, the rapid commercialization of plant-based products may accelerate the proliferation of ultra-processed alternatives that, although environmentally preferable to certain animal-derived foods, do not necessarily align with optimal nutritional quality or long-term public health objectives. Thus, future research and policy efforts must also address how plant-based food is produced, distributed, industrialized, and integrated into socioeconomic frameworks, recognizing that these structural factors might shape the actual sustainability of contemporary dietary transitions.

4. Plant-Based Diets and Human Health Outcomes

Evidence suggests that plant-based dietary patterns may confer important health advantages compared with contemporary Western-style diets [49–52]. As previously noted, research has reported associations between greater adherence to plant-based diets and lower risk of several health-related conditions, including cardiovascular disease, cancer, T2D, overweight, obesity, dyslipidemia, hypertension, and metabolic syndrome (MetS) [13,20,23,29,53,54]. Nevertheless, although these findings are promising, additional high-quality evidence is still required to conclusively establish causality and strengthen current recommendations [13]. Health-related motivations remain among the principal factors driving the adoption of plant-based and alternative dietary models, particularly among individuals with a strong interest in nutrition and lifestyle optimization. In this respect, Bogataj Jontez et al. [55] compared nutrient intake and serum metabolic biomarkers among individuals following self-selected dietary regimens, including low-carbohydrate high-fat (LCHF), vegan, vegetarian, and omnivorous diets. Their results indicated that, despite achieving comparable micronutrient intake, individuals adhering to LCHF diets exhibited higher consumption of saturated fat and cholesterol together with lower fiber intake, suggesting that greater incorporation of plant-based foods and healthier lipid sources may improve nutritional adequacy within these dietary patterns. Similarly, a systematic review evaluating the nutritional quality of vegetarian diets reported overall superior nutritional profiles among vegetarians compared with omnivorous populations [56]. Consistent with these observations, the Academy of Nutrition and Dietetics has stated that appropriately planned vegetarian diets can provide adequate nutrition throughout all stages of the life cycle, although careful dietary planning remains necessary to reduce the risk of potential nutrient deficiencies [52]. In addition, not all plant-based foods exert comparable effects on human health, as the nutritional quality of plant-based dietary patterns may differ

substantially according to the specific foods consumed. Plant-based diets characterized by high intakes of refined grains, hydrogenated fats, high-fructose corn syrup, sucrose, artificial sweeteners, sodium, and other highly processed ingredients have been associated with increased morbidity and mortality risk [57–59]. These findings highlight that the potential health benefits of plant-based dietary patterns depend on the reduction or exclusion of animal-derived foods and also on the predominance of minimally processed and nutritionally dense plant foods.

4.1. Vegetarian Diets Across Health-Related Conditions

Vegetarian diets, by excluding meat and its derivatives, can reduce the potential health risks associated with high intake of animal protein, saturated fats, heme iron, and the production of trimethylamine-N-oxide, via multiple physiological mechanisms [60]. These diets are generally characterized by a higher proportion of plant-based foods, which contributes to increased consumption of complex carbohydrates, dietary fiber, polyunsaturated fatty acids, essential micronutrients such as magnesium and potassium, and bioactive phytochemicals [61]. Collectively, these nutrients exert synergistic effects that have been associated with a lower incidence of metabolic disorders, including overweight, T2D, and hypercholesterolemia [28]. The beneficial impacts of vegetarian diets are partly mediated by their antioxidant, anti-inflammatory, immunomodulatory, antiproliferative, and antihypertensive properties, as well as their capacity to positively influence the GM. In turn, this modulation enhances the microbial production of short-chain fatty acids and postbiotics such as equol, urolithins, enterolignans, vitamins, isothiocyanates, coprostanol, and secondary bile acids, which collectively support diverse physiological and immunological functions [62].

4.1.1. Cancer

Cancer is a multifactorial disease arising from the interplay between genetic predispositions and environmental exposures. This dynamic interaction can induce DNA damage, disrupt normal cellular regulation, and ultimately lead to uncontrolled cell proliferation. Diet has long been recognized as a critical modifiable factor influencing both cancer initiation and progression. The pathways through which dietary components affect cancer risk are diverse, encompassing genotoxic, cytotoxic, and inflammatory mechanisms [60]. High consumption of red meat, whether processed or unprocessed, has consistently been associated with elevated cancer risk, particularly colorectal cancer. Conversely, the impact of many other foods on cancer susceptibility remains less clearly defined. Nevertheless, evidence summarized in the World Cancer Research Fund (WCRF) report highlights the protective potential of plant-based foods, including whole grains, non-starchy vegetables, fruits, high-fiber unprocessed plant foods, beta-carotene-rich foods, and soy products [63].

Observational research has extensively investigated the relationship between dietary patterns and cancer incidence. Evidence from the Oxford cohort study, which followed more than 61,000 participants for approximately 12 years, demonstrated markedly lower incidence rates of several malignancies among vegetarian individuals compared with non-vegetarians, including gastric, bladder, and lymphatic-hematopoietic cancers. In addition, reductions in overall cancer risk were observed among both fish-eaters and vegetarians [64]. Similar findings were obtained from the Adventist cohort study conducted in 2013, involving nearly 70,000 participants monitored over approximately four years, in which lacto-ovo vegetarian dietary patterns were associated with lower risk of gastrointestinal cancers, while vegan diets showed protective associations for female-specific cancers as well as overall cancer incidence [65]. More recently, data derived from the UK Biobank cohort, comprising over 470,000 individuals with an average follow-up close to 11 years, reported

that vegetarian diets were associated with reduced risk of colorectal, postmenopausal breast, and prostate cancers, along with a lower incidence of total cancer [66].

Evidence derived from multiple meta-analyses of observational studies consistently indicates an inverse association between vegetarian dietary patterns and overall cancer risk. Huang et al. [67] analyzed seven studies including approximately 125,000 participants and reported an 18% reduction in total cancer incidence among vegetarians. Similarly, Dinu et al. [50] separately evaluated lacto-ovo vegetarians and vegans, encompassing 38,033 and 7168 individuals, respectively, and observed reductions in overall cancer risk of 8% among lacto-ovo vegetarians and 15% among vegans. In a larger analysis involving nearly 550,000 participants, Parra-Soto et al. [68] identified a 10% lower risk for total cancer and a 15% reduction in colorectal cancer risk among vegetarians compared with meat-eaters. More extensive evidence was provided by Zhao et al. [69], who examined the association between plant-based dietary patterns and digestive system cancers across 49 studies including more than three million individuals. Their findings demonstrated significant protective associations for overall digestive system cancers as well as for several specific anatomical sites, including pancreatic, colorectal, colon, rectal, and liver cancers, in both cohort and case–control studies. Moreover, subgroup analyses according to dietary pattern revealed stronger protective associations among individuals adhering to vegan diets compared with other plant-based dietary models [69].

4.1.2. Overweight and Obesity

Overweight and obesity are closely related conditions characterized by an excess accumulation of body mass. However, they differ in their clinical significance and underlying pathophysiology: while overweight generally refers to an increase in body weight relative to height and may be primarily associated with lifestyle factors such as excessive energy intake and physical inactivity, obesity is currently recognized as a chronic disease involving complex interactions among genetic, metabolic, and environmental determinants that lead to excessive adipose tissue accumulation impairing physiological function and substantially increasing the risk of cardiometabolic disorders and other chronic diseases [70]. Standing out because of their high prevalence and easy clinical recognition, overweight and obesity disproportionately affects individuals from lower socioeconomic groups in high-income countries, whereas in many low- and middle-income countries they have traditionally been perceived as an indicator of prosperity and higher social status [71]. As previously noted, beyond being conditions in their own right, overweight and obesity can also constitute a major risk factors for a range of adverse health outcomes, including T2D and several forms of cancer [72]. The development of these conditions is particularly affected by a sustained imbalance between energy intake and energy expenditure. This imbalance may arise from reduced physical activity and the consequent decline in energy expenditure, excessive caloric intake, or a combination of both factors. Consequently, dietary patterns play a pivotal role in determining the extent to which energy overconsumption contributes to weight gain.

Higher consumption of animal-derived foods has been consistently associated with increased body weight (BW). In the 2009 Adventist cohort study, Tonstad et al. [73] reported a clear gradient in body mass index (BMI) across dietary patterns, with vegetarians exhibiting lower BMI values than meat eaters. A progressive transition from meat-eater to semi-vegetarian, fish-eater, lacto-ovo-vegetarian, and vegan diets was associated with progressively lower BMI, culminating in a mean difference of 5.2 kg/m^2 between meat-eaters and vegans [73]. Plant-based diets have also demonstrated benefits in bone health, contributing to the prevention and non-pharmacological management of osteoporosis. For instance, in a two-year intervention study comparing a very-low-carbohydrate diet with the

National Cholesterol Education Program (NCEP) diet in 62 women, both groups exhibited BW reduction during the first 12 months. However, in the second year, the NCEP diet group experienced partial weight regain, whereas participants following the intervention diet maintained and further improved their weight loss [74].

Several meta-analyses evaluating the relationship between dietary patterns and BW or BMI consistently indicates that plant-based diets exert beneficial effects in both the prevention and management of overweight and obesity [50,75–79]. Reflecting this evidence, the Academy of Nutrition and Dietetics has highlighted that healthcare professionals should recognize the effectiveness of vegetarian diets in achieving and maintaining a healthy weight. Moreover, they further emphasize that vegetarian dietary patterns demonstrate therapeutic efficacy for weight management, often surpassing that of conventional omnivorous diets [52]. Intervention trials support these insights, demonstrating that adherence to vegetarian diets, particularly low-fat vegan regimens, produces greater weight reduction than non-vegetarian diets [53]. Thus, these findings may help explain why vegetarian diets are commonly recommended in clinical practice as an effective dietary approach for preventing chronic diseases, managing cardiovascular disorders, and improving overall health outcomes [23].

4.1.3. Type 2 Diabetes

Obesity is frequently complicated by T2D, a metabolic disorder characterized by impaired glucose homeostasis that predisposes individuals to both acute and long-term complications, as well as an increased risk of cardiovascular disease [80]. Epidemiological evidence consistently indicates a positive association between meat consumption and T2D risk. Notably, a 2011 meta-analysis including approximately 440,000 participants reported that each 100 g increment in daily red meat intake corresponded to a 19% higher risk of developing T2D, while a 50 g daily increase in processed meat intake was linked to a 51% elevated risk [81]. Proposed mechanisms underlying these associations include the high content of heme iron, saturated fatty acids, branched-chain amino acids, choline and carnitine, nitrosamines and other nitros compounds, advanced glycation end-products (AGEs), and the induction of insulin resistance. Conversely, consumption of plant-based foods has been associated with protective effects against insulin resistance and T2D, largely attributed to their abundant dietary fiber [82]. In a clinical intervention, adherence to a low-fat vegan diet emphasizing unrestricted intake of minimally processed plant foods and the exclusion of added fats resulted in a 73% reduction in dietary AGEs intake, whereas no significant change was observed in participants following a Mediterranean diet. Furthermore, reductions in dietary AGEs were correlated with BW changes, with a mean weight loss of 6 kg observed in the vegan diet group, compared to no significant change in the Mediterranean diet cohort [83].

Data from the Adventist cohort indicate a clear association between dietary patterns and diabetes prevalence. Among approximately 61,000 participants evaluated at baseline, the prevalence of diabetes was highest among individuals consuming diets that included animal products and lowest among those following vegetarian diets, although not necessarily vegan diets (7.6% in non-vegetarians versus 2.9% in vegetarians) [73]. Further evidence from the same cohort, based on a 2-year follow-up of approximately 41,000 participants free of diabetes at enrollment, demonstrated that adherence to vegetarian dietary patterns was associated with a markedly lower incidence of T2D. Compared with non-vegetarians, the risk of developing diabetes was reduced by 62% among individuals adhering to fully vegetarian diets, by 51% among semi-vegetarians, and by 38% among those with less restrictive plant-oriented dietary habits [73]. Consistent with these findings, a meta-analysis conducted by Lee and Park [84] reported that vegetarian diets were associated with a

27% lower risk of T2D relative to non-vegetarian dietary patterns. Beyond their preventive role, plant-based diets have also shown therapeutic potential in the management of hyperglycemia. In a multicenter clinical trial, participants assigned to a low-fat vegan diet experienced a 0.74% reduction in glycated hemoglobin after 18 weeks compared with those maintaining their habitual diet [85]. Mechanistic studies further support these clinical benefits. As reported by Kahleova et al. [86], consumption of a low-fat plant-based diet was associated with significant reductions in both hepatocellular and intramyocellular lipid accumulation, along with improvements in insulin sensitivity, suggesting a potential pathway through which plant-based dietary interventions contribute to glycemic control. All these findings are consistent with those of additional meta-analyses [87,88], as well as with the recommendations of the Canadian Diabetes Association, which advocate for the adoption of plant-based dietary patterns as a strategy for diabetes management [89]. Similarly, the Academy of Nutrition and Dietetics highlights that vegetarian diets represent a promising approach for both the prevention and treatment of T2D. This beneficial effect is largely attributed to the combination of reduced saturated fat intake and increased consumption of vegetables, fruits, whole grains, legumes, soy products, nuts, and seeds, which are rich in fiber and bioactive phytochemicals capable of improving glycemic control [52]. Supporting this perspective, a comprehensive review by the Italian Society for Human Nutrition indicates that evidence from both cohort and intervention studies consistently demonstrates that vegetarian diets favorably impact the risk and management of T2D [53].

4.1.4. Dyslipidemia

Elevated concentrations of total cholesterol (TC), LDL-C, and non-high-density lipoprotein cholesterol (non-HDL-C) are well-established risk factors for cardiovascular disease. Circulating cholesterol levels are determined by multiple factors, including smoking status, physical activity, genetic background, sex, and age [90]. In addition, dietary habits and metabolic disorders such as obesity and T2D substantially influence lipid homeostasis. Several dietary components have been associated with adverse lipid profiles, particularly saturated fats, trans fats, and dietary cholesterol, which are primarily derived from animal products and some highly processed plant-based foods. Moreover, excessive consumption of alcohol and added sugars has been linked to increased triglyceride concentrations [28]. Evidence from observational studies further supports the association between dietary patterns and lipid levels. In the Oxford cohort, baseline measurements showed that both TC and apolipoprotein B concentrations were highest among meat consumers and lowest among vegetarians, with similar trends observed in both men and women [91]. Intervention studies have yielded comparable findings. In the multicenter GEICO trial, participants assigned to an *ad libitum* low-fat vegan diet experienced a significant reduction in TC concentrations, with levels decreasing by 13.7 mg/dL after 18 weeks compared with individuals who continued their habitual dietary practices [85]. Furthermore, evidence from a meta-analysis encompassing 30 observational studies and more than 10,000 participants indicates that adherence to vegetarian dietary patterns is associated with lower circulating concentrations of TC, LDL-C, and HDL-C [92]. These findings are further supported by subsequent meta-analyses [50,76], which suggest that the magnitude of lipid-lowering effects differs according to the type of vegetarian diet. When lacto-ovo-vegetarian and vegan diets are evaluated separately, vegan dietary patterns generally appear to produce greater reductions in blood cholesterol levels than lacto-ovo-vegetarian diets. With respect to triglycerides, the available evidence is less consistent. Among the reviewed meta-analyses, only Benatar et al. [76] reported a statistically significant reduction in circulating triglyceride concentrations among individuals following vegan diets compared with their omnivorous counterparts.

Consistent with the aforementioned evidence, several additional meta-analyses of intervention studies have consistently demonstrated the efficacy of vegetarian diets in reducing serum cholesterol concentrations [69,82,84]. Nevertheless, the effect of vegetarian diets on HDL-C remains controversial. Some meta-analyses have reported decreases in HDL-C, occasionally reaching statistical significance, which raises questions because HDL-C has traditionally been considered cardioprotective. However, evidence from a meta-analysis of randomized controlled trials by Keene et al. [93] involving 117,411 participants indicates that increasing HDL-C levels does not confer a reduction in vascular risk. Supporting this notion, genetically determined low HDL-C levels have not been associated with heightened risk of ischemic heart disease [94]. In turn, other authors have argued that HDL-C is unlikely to serve as a cardiovascular-specific risk marker, given its similar associations with non-cardiovascular outcomes [95].

4.1.5. Hypertension

Hypertension is defined differently across major clinical guidelines. The European Society of Hypertension classifies hypertension as blood pressure values equal to or exceeding 140/90 mmHg [96], whereas the American College of Cardiology and the American Heart Association (ACC/AHA) adopt a lower diagnostic threshold of 130/80 mmHg [97]. The development of hypertension is complex and results from the interaction of genetic predisposition with environmental and lifestyle determinants. Established modifiable risk factors include tobacco use, physical inactivity, excessive alcohol consumption, obesity, T2D, and poor dietary habits. Given its strong association with cardiovascular morbidity and mortality, even modest reductions in blood pressure can yield substantial health benefits. Indeed, a 5 mmHg decrease in systolic blood pressure has been associated with reductions of 7% in all-cause mortality, 9% in mortality from cardiac causes, and 14% in stroke-related mortality [98].

Data from the Adventist cohort indicate that adherence to plant-based dietary patterns is associated with a markedly lower risk of developing hypertension. Compared with regular meat consumers, the odds of hypertension were 8% in semi-vegetarians, 43% in lacto-ovo vegetarians, and 63% in vegans [99]. These findings are supported by various meta-analyses of observational studies, which have consistently reported that vegetarian diets are linked to reductions in both systolic and diastolic blood pressure. Specifically, a meta-analysis of 32 observational studies found that individuals following vegetarian diets exhibited lower mean systolic and diastolic pressures relative to omnivorous counterparts [88]. Among vegans, Benatar et al. [76] reported average reductions of 2.56 mmHg in systolic and 1.33 mmHg in diastolic blood pressure. However, these effects were primarily observed in non-Asian populations, with minimal changes detected in Asian cohorts. In contrast, meta-analyses of intervention trials have yielded less consistent results, with some studies failing to demonstrate significant blood pressure reductions in vegetarian participants [78,87,88].

4.1.6. Metabolic Syndrome

MetS comprises a constellation of interrelated cardiometabolic abnormalities, including obesity, hypertension, and disturbances in glucose and lipid metabolism [100]. Despite its widespread clinical use, no single definition of MetS has achieved universal acceptance. Nevertheless, insulin resistance is generally regarded as the central pathophysiological feature underlying the syndrome. Accumulating evidence indicates that plant-based dietary patterns, particularly low-fat vegan diets, can enhance insulin sensitivity and thereby target a key mechanism involved in MetS development [86]. In contrast, increased BW

and elevated iron stores have both been associated with greater insulin resistance, further contributing to metabolic dysfunction [101,102].

A cross-sectional analysis of the Adventist cohort demonstrated that adherence to plant-based diets, including both vegetarians and semi-vegetarians, was associated with a 56% lower risk of MetS. Furthermore, individual components of MetS were generally more favorable among vegetarians compared with omnivores [103]. Similarly, Chiang et al. [104] reported a reduction in insulin resistance by 29% and decreases in MetS risk of 57% and 54% in Asian vegetarians who had followed a vegetarian diet for more or less than 11 years, respectively. However, a comprehensive meta-analysis by Picasso et al. [105] found no statistically significant association between vegetarian diets and reduced MetS risk when cross-sectional studies were pooled. The analysis also highlighted substantial heterogeneity, which obscured potential associations between vegetarian diets and specific MetS components such as systolic and diastolic blood pressure, HDL-C, and fasting glucose. The lack of consistency across studies is further emphasized by the Italian Society for Human Nutrition, which notes that disparate definitions and classifications of MetS contribute to difficulties in comparing results [53].

4.1.7. Vascular Disease

Atherosclerosis, characterized by the accumulation of plaque within the arterial walls, can affect vessels throughout the body and, when involving critical organs such as the heart and brain, contributes to the development of vascular disease (VaD) [106]. Evidence from prospective studies in both the Oxford and Adventist cohorts has consistently shown that vegetarian dietary patterns confer protective effects against VaD. In the Oxford cohort, adherence to a vegetarian diet was associated with a 32% reduction in ischemic heart disease-related mortality and hospitalization, whereas in the Adventist cohort, vegetarians experienced a 55% reduction in ischemic heart disease mortality, a 42% reduction in overall VaD mortality, and a 23% reduction among lacto-ovo-vegetarians [107]. Similarly, two prospective cohorts in Taiwan reported lower risks of total, ischemic, and hemorrhagic strokes among vegetarians. In cohort 1, the risk of ischemic stroke was reduced by 74%, while in cohort 2, total stroke risk decreased by 48%, ischemic stroke risk by 59%, and hemorrhagic stroke risk by 66% [108]. These observational findings are supported by several meta-analyses, which consistently demonstrate that vegetarian diets are associated with lower incidence and mortality from ischemic heart disease compared with omnivorous diets [50,67,109,110]. However, these studies have generally not found a statistically significant effect of vegetarian diets on overall stroke incidence.

4.2. Aligning Health and Environmental Outcomes with Vegetarian Diets

Building on the aforementioned, current evidence indicates that vegetarian dietary patterns are consistently associated with lower risks of obesity, T2D, dyslipidemia, hypertension, vascular disease, and several forms of cancer, while also contributing to improvements in key cardiometabolic risk factors, including BW, glycemic control, insulin sensitivity, and serum cholesterol levels. Although the magnitude and consistency of these effects may vary across health outcomes and study designs, the overall body of evidence supports plant-based dietary patterns as an effective strategy for the prevention and management of major chronic non-communicable diseases. However, assessing the alignment between health and environmental outcomes requires studies that evaluate both dimensions simultaneously. Overall, the available evidence indicates that vegetarian dietary patterns are associated with improvements in both human health and environmental sustainability, including vegetarian and vegan diets [26,37,40,43,111]. Nevertheless, the relationship between nutritional quality and environmental impact is not always linear.

For instance, Vieux et al. [112] reported that certain nutritionally poor foods, such as sugary products and salty snacks, may generate lower environmental impacts per calorie than fruits and vegetables, which were associated with higher GHGEs. This finding highlights that health and environmental performance may either converge or diverge depending on the specific composition of the diet. In this context, two systematic reviews evaluated the combined health and environmental consequences of transitioning from prevailing dietary patterns to alternative dietary models [16,113]. Although both reviews reached similar conclusions regarding the potential overall benefits of plant-based diets, one of them concluded that a transition to vegan diets would be expected to produce greater health gains and larger environmental benefits than a shift toward other types of vegetarian diets [16]. In turn, reductions in GHGEs do not automatically translate into improved nutritional quality or better health outcomes. Consequently, dietary strategies aimed at mitigating climate change should extend beyond reducing meat consumption and also promote moderation in the intake of sugar-rich foods while ensuring adequate micronutrient provision [114]. In this respect, from a future perspective, policymakers might consider incentivizing the development of plant-based foods that are both nutritionally rich and environmentally sustainable, such as legumes fortified with micronutrients or algae-based protein products. Moreover, from a research perspective, integrating life cycle assessments with longitudinal dietary interventions could provide a more precise understanding of how different plant-based diets (e.g., lacto-ovo-vegetarian diets, vegan diets) influence both human and planetary health, revealing the differential advantages of each pattern across diverse domains, as well as the aspects that could be strengthened to establish the most optimal dietary model. However, for these important investigations to take place, substantial funding is required, which in turn necessitates governments committed to initiatives promoting a transition toward sustainable dietary patterns, implemented early in life and in high-influence settings such as schools [8]. Customized plant-based nutrition programs that account for individual metabolic responses, GM composition, and lifestyle factors might further optimize outcomes, achieving maximal reductions in chronic disease risk without compromising environmental sustainability, but educational initiatives promoting ethical principles and awareness of both nutritional and ecological impacts will be pivotal for empowering populations to adopt plant-based patterns that are simultaneously health-promoting and environmentally responsible.

5. Vegetarianism: More than a Dietary Choice

Nutrition may represent far more than a means of satisfying physiological requirements, with some dietary patterns holding particular significance within the current societal landscape. Adherence to a vegetarian diet extends beyond food choices, representing a lifestyle commitment based on transcendental principles. Vegetarianism functions as a social identity, reflecting the values, beliefs, and attitudes of individuals who embrace this dietary pattern [115]. Its adoption involves a combination of ethical, health, and environmental considerations, potentially influencing multiple aspects of personal well-being. For this reason, vegetarianism may have important implications for overall quality of life (QoL), extending across physical, psychological, social, and environmental domains.

5.1. Vegetarian Diets and Quality of Life

The World Health Organization (WHO) defines QoL as a multidimensional construct encompassing physical (i.e., overall physiological health and functional capacity), psychological (i.e., cognitive and emotional well-being), social (i.e., interpersonal relationships and societal roles), and environmental (i.e., the characteristics of the surrounding physical and social environment) domains [116]. Adherence to a vegetarian diet might influence these

QoL domains, resulting in differential outcomes depending on the context and individual circumstances [117]. At the same time, specific aspects of each domain may shape an individual's attitude toward vegetarian dietary patterns. Table 1 provides a synthesis of survey-based evidence exploring the impact of vegetarian diets on QoL.

Table 1. Studies conducted on the effects of vegetarian diets on quality of life.

Study/Country	Participants	Instruments	Results
Boldt et al. [118] (Germany, Austria and Switzerland)	*N* = 281 recreational runners (159 women, 122 men)	WHOQOL-BREF	Men scored higher than women, mainly due to better physical health and psychological well-being. Endurance runners showed high QoL regardless of race distance or diet. These results support vegetarian and vegan diets as appropriate and equivalent alternatives to omnivorous diets.
Hargreaves et al. [119] (Brazil)	*N* = 5014 Brazilian vegetarians (3025 women, 1989 men)	VEGQOL	Overall, the quality of life of Brazilian vegetarians was satisfactory (VEGQOL cut-off 70–80). Vegans showed the highest scores (79.2 ± 10.7). Higher quality of life was also observed in older individuals, those with longer diet duration (75.8 ± 12.7), and those with vegetarian social networks (74.6 ± 12.2). Individuals adopting the diet for ethical or health reasons also reported higher scores.
Kahleova et al. [120] (Czech Republic)	*N* = 74 subjects with type 2 diabetes (39 women, 35 men)	OWLQOL, WRSM	A vegetarian diet led to greater improvements in QoL and mood. Participants felt less dietary restraint than those on a conventional diet, and showed a greater reduction in hunger and disinhibition. These findings suggest that a vegetarian diet is sustainable long term and may improve both physical and mental health in patients with type 2 diabetes.
Katcher et al. [121] (USA)	*N* = 65 vegan workers with type 2 diabetes	EI, FAQ, SF-36, WPAI	A worksite vegan nutrition program is well accepted and can be implemented by employers to improve employees' health, QoL, and productivity.
Krizanova and Guardiola [122] (Spain)	*N* = 1068 university students (662 women, 406 men)	SWB, PANAS	Results suggest that vegetarianism and specific vegetarian identities (especially vegan identity) are positively influenced by connectedness to nature in relation to SWB. Vegetarians report greater happiness when they experience higher levels of connection with nature.
Link et al. [123] (USA)	*N* = 51 attendees at Hippocrates Health Institute completed the survey (38 women, 13 men)	SF-36, PSS, HADS	A stay at a raw vegan institute was associated with improved mental and emotional QoL.
Obeidat et al. [124] (United Arab Emirates)	*N* = 180 female college students	VEGQOL, PSQI, HRQOL	No significant relationships were found between a vegetarian diet and academic performance, HRQOL, or sleep quality.
Pfeiler and Egloff [125] (Germany and Australia)	Germany (Study 1: *N* = 12,905, including 665 vegetarians) and Australia (Study 2: *N* = 15,532, including 383 vegetarians)	SWB	Results regarding *t*-tests showed vegetarians had slightly higher negative affect (Studies 1 and 2), but also slightly higher health satisfaction (Studies 1 and 2) and life satisfaction (Study 1) than meat eaters. Although statistically significant due to large samples, these differences were very small. After accounting for socio-demographic variables, the effects appear negligible, suggesting no meaningful impact of diet on SWB.

WHOQOL-BREF, World Health Organization Quality of Life Assessment-brief; VEGQOL, Vegetarian Quality of Life Questionnaire; OWLQOL, Obesity and Weight-Loss Quality of Life; WRSM, Weight-Related Symptoms Measure; EI, Eating Inventory; FAQ, Food Acceptability Questionnaire; SF-36, Short Form-36; WPAI, Work Productivity and Activity Impairment; SWB, Subjective Well-Being; PANAS, Positive and Negative Affect Schedule; PSS, Perceived Stress Scale; HADS, Hospital Anxiety and Depression Scale; PSQI, Pittsburgh Sleep Quality Index; HRQOL, Health-Related Quality of Life Scale.

Boldt et al. [118] conducted a cross-sectional study involving 281 recreational endurance runners who completed the brief version of the World Health Organization Quality of Life Assessment (WHOQOL-BREF), which evaluates physical health, psychological well-being, social relationships, and environmental domains. Among the participants,

123 followed an omnivorous diet, while 158 adhered to a vegetarian or vegan dietary pattern. Overall, men reported higher scores than women, primarily due to elevated ratings in physical health and psychological well-being. Notably, diet appeared to influence specific domains: omnivorous women reported higher environmental scores, whereas omnivorous men exhibited higher social relationship scores. A modest effect of race distance was observed in women, with half-marathon runners scoring higher in the environmental domain than 10 km participants. The authors concluded that endurance runners generally maintain high QoL regardless of diet or race distance, supporting the notion that vegetarian and vegan diets provide a viable alternative to omnivorous patterns. In turn, Hargreaves et al. [119] assessed QoL among vegetarians in Brazil, reporting satisfactory levels across all domains (i.e., average scores between 70 and 80 on a 100-point scale), with vegans achieving the highest overall scores. Additional factors influencing QoL included age, duration of adherence to vegetarianism, and the presence of other vegetarians within one's social network. Similarly, a clinical trial in patients with T2D compared a vegetarian diet to a standard diabetes management diet, using the Obesity and Weight-Loss QoL (OWQOL) and Weight-Related Symptom Measure (WRSM) questionnaires. Both dietary interventions improved QoL and mood. However, the vegetarian group demonstrated greater benefits, indicating that plant-based diets may positively affect both physical and mental health in this population [120]. In a workplace-based health promotion study, Katcher et al. [121] evaluated the impact of a 22-week vegan diet on employees using the Food Acceptability Questionnaire (FAQ) and the Work Productivity and Activity Impairment (WPAI) survey. Participants reported improvements in general health, physical fitness, mental health, vitality, and overall satisfaction with their diet, along with reduced food costs, although challenges in finding suitable meals when dining out were noted. Furthermore, a study conducted at a U.S. health institute providing a raw vegan diet to guests assessed QoL among participants who maintained the diet for at least one week and continued adherence after leaving the facility. QoL was measured at baseline and 12 weeks post-intervention, incorporating assessments of taste satisfaction, food cost, convenience (i.e., ease of planning, purchasing, and preparing meals), and self-care perception. Individuals following the raw vegan diet demonstrated significant improvements in both general QoL (assessed via SF-36) and diet-specific measures, emphasizing the potential benefits of structured plant-based dietary interventions in clinical and lifestyle contexts [123].

5.2. Physiological Insights into Vegetarian Diets

Physical well-being encompasses a range of factors related to organism function, including pain and discomfort, energy and fatigue levels, as well as sleep quality and rest. As a result, determinants that contribute to favorable physiological health play a central role in shaping overall QoL [126]. Among these are improved health status, a lower prevalence of chronic and inflammatory conditions, and increased longevity. In this context, vegetarian dietary patterns, including vegan diets, are widely recognized as health-promoting and nutritionally adequate when appropriately planned. Current evidence indicates that such diets can satisfy the nutritional requirements of individuals throughout all stages of the life cycle while providing potential benefits for the prevention and management of several chronic diseases [23].

5.2.1. Underlying Key Mechanisms

As previously noted, vegetarian diets may contribute to the prevention and management of various health conditions. In this respect, a range of underlying mechanisms might be involved in the beneficial effects associated with these dietary patterns. The GM plays a pivotal role in regulating numerous biological processes and modulating the risk

of chronic diseases, with diet serving as a primary determinant of GM composition and enteric health [127–129]. Excessive intake of animal-derived proteins has been shown to alter GM composition by promoting the proliferation of proteolytic bacteria. The metabolic byproducts of amino acid fermentation, such as hydrogen sulfide, ammonia, and p-cresol, have been associated with increased intestinal inflammation, compromised barrier integrity, and exacerbation of colitis, as well as with metabolic disorders including obesity, T2D, and non-alcoholic fatty liver disease [130]. Furthermore, some of these fermentation byproducts may contribute to the development and progression of colorectal cancer. In contrast, protein from plant-based sources appears to avoid these detrimental effects, likely due to its concomitant content of carbohydrates and fiber, which modulate bacterial metabolism and mitigate harmful proteolytic activity [130]. Vegetarian diets are typically characterized by higher intakes of dietary fiber and complex carbohydrates, along with lower levels of total and saturated protein. Research on the GM in vegetarians suggests that plant-based dietary patterns might enhance microbial diversity and promote a beneficial bacterial profile [127]. These changes increase the production of health-promoting metabolites derived from the fermentation of prebiotics and phytochemicals, which exert positive effects both locally within the gut and systemically, thereby contributing to chronic disease prevention and overall host health [61,131].

Within the context of chronic disease prevention and management, clinical trials incorporating lifestyle interventions, including vegetarian, vegan, and other plant-based dietary patterns, have reported favorable effects on several major cardiovascular risk factors [132,133]. Adherence to a well-balanced vegetarian diet has also been associated with reductions in systemic inflammation and a lower risk of T2D, both of which may play a role in the development and progression of cardiovascular disease [134]. The protective effect of vegetarian diets against diabetes appears to be mediated by multiple interconnected mechanisms. One of the most important is improved body weight regulation, as vegetarians generally exhibit lower rates of obesity and reduced visceral adiposity, two conditions strongly associated with insulin resistance and subsequent diabetes development [70]. In addition, evidence suggests that reducing saturated fat intake or replacing saturated fats with unsaturated fatty acids can enhance insulin sensitivity [135]. Other dietary characteristics commonly observed in vegetarian populations, including higher fiber consumption, lower ferritin concentrations, and reduced exposure to heme iron, have similarly been linked to improved glucose metabolism and also to a decreased risk of diabetes [136,137]. Collectively, these factors contribute to better insulin sensitivity and may help explain the lower incidence of diabetes consistently observed among individuals following vegetarian dietary patterns.

Plant-derived foods are rich sources of antioxidant compounds that play a key role in maintaining cellular homeostasis. Beyond their capacity to neutralize reactive oxygen species, these bioactive molecules can function as signaling mediators, regulating immune activity and promoting the endogenous synthesis of antioxidant enzymes and protective compounds, thereby attenuating inflammatory processes [138]. Such mechanisms may partly explain the association between vegetarian dietary patterns and a lower risk of certain cancers [139]. Dietary fiber, a hallmark of plant-based diets, has also been proposed as an important protective factor through its ability to modulate GM composition and activity, fostering a microbial environment that supports intestinal and systemic health [62]. In contrast, excessive protein intake, particularly from animal sources, may increase the generation of potentially harmful metabolites through microbial proteolytic fermentation, contributing to a pro-inflammatory milieu [130]. Moreover, saturated fatty acids, which are abundant in many animal-derived foods, have been shown to activate Toll-like receptors expressed on immune cells, triggering signaling pathways that promote the production of

pro-inflammatory cytokines [140]. Thus, these mechanisms involved in the consumption of animal-derived foods may favor the establishment of chronic low-grade inflammation and a biological environment that facilitates carcinogenesis and tumor progression.

5.2.2. Nutritional and Lifestyle Considerations

A range of lifestyle-related factors has been recognized as influential determinants of disease risk and lifespan. Research on so-called Blue Zones (i.e., regions where populations exhibit exceptional longevity) indicates that the habitual incorporation of regular physical activity, effective stress management, strong social connections, and nutritionally balanced diets collectively supports healthy aging and extended life expectancy [141]. Notably, dietary patterns in these regions are predominantly plant-based, emphasizing legumes, vegetables, tubers, whole grains, fruits, and region-specific foods, with limited inclusion of animal-derived products such as dairy [141]. This combination of diet and lifestyle behaviors appears to synergistically contribute to the reduction in chronic disease prevalence and the promotion of long-term health. Thus, adopting a vegetarian diet has the potential to enhance physical health and overall well-being, but particular attention must be directed toward ensuring adequate intake of critical nutrients, such as iron, zinc, vitamins B12 and D, calcium, iodine, omega-3 fatty acids, and protein, especially in vulnerable populations such as infants, children, and adolescents [8,142]. Indeed, insufficient consumption of these nutrients may lead to measurable adverse outcomes, including micronutrient deficiencies, compromised growth and development, and diminished physical and cognitive functioning [143]. Research has reported that vegetarians, and particularly vegans, tend to exhibit lower serum concentrations of vitamin B12 along with elevated homocysteine levels compared with omnivorous populations [144]. These alterations are of clinical relevance, as vitamin B12 deficiency and hyperhomocysteinemia have been associated with a variety of adverse health outcomes, including megaloblastic anemia, neurological dysfunction, and impaired growth and neurodevelopment in children [144,145]. Moreover, these metabolic disturbances may contribute to an increased risk of cardiovascular disease, cognitive decline, dementia, osteoporosis, and all-cause mortality. Iron status has also received considerable attention in the context of vegetarian nutrition. Research indicates that individuals following vegetarian dietary patterns generally exhibit lower serum ferritin concentrations, reflecting reduced body iron stores [146]. Although lower ferritin levels may be beneficial in certain metabolic contexts, inadequate iron status can increase the risk of iron deficiency and anemia, particularly among populations with elevated physiological requirements. In addition, vitamin B12 deficiency may further contribute to the development of anemia in vegetarian individuals [145]. Bone health represents another area of concern when evaluating the potential nutritional limitations of certain plant-based dietary patterns. Evidence suggests that vegans might present lower bone mineral density than omnivores [147,148]. While reduced calcium intake has frequently been proposed as a contributing factor, bone metabolism could be influenced by a complex interplay of alternative nutritional determinants. In addition to calcium, nutrients such as vitamins A and B2, lysine, zinc, iodine, n-3 fatty acids, and selenoprotein P appear to play important roles in maintaining skeletal integrity, highlighting the need for carefully planned vegetarian diets that ensure adequate intake of all nutrients involved in bone health [147,148].

5.3. Psychosocial Insights into Vegetarian Diets

Abstaining from meat and other animal-derived foods may generate positive psychological outcomes, particularly when dietary choices are consistent with an individual's ethical values and personal beliefs. In this respect, vegetarianism may become an important component of personal identity, shaping how individuals perceive themselves, interact

with others, and engage with society [115]. Furthermore, following a vegetarian diet has also been associated with greater life satisfaction, a factor that may contribute to its adoption and long-term maintenance [149]. Taking into account that a social environment with healthy relationships has been recognized as an essential determinant of mental health and overall well-being, contributing substantially to QoL [150], the psychosocial implications and correlates of adopting a vegetarian diet should be considered within the broader cultural context in which individuals are embedded.

5.3.1. Motivational Domain

The decision to follow a vegetarian diet is shaped by diverse motivations. Ethical considerations, particularly concerns regarding the moral implications of animal slaughter, are among the major reasons for adopting a vegetarian diet [8]. Health-related factors, including the potential benefits of plant-based eating for disease prevention and overall well-being, also play a prominent role [11]. In addition, cultural and religious influences such as doctrines that prescribe abstention from meat, along with growing awareness of the environmental impact of animal agriculture, further contribute to the choice to adopt a vegetarian diet [37,119,126].

Motivations for adopting vegetarian diets appear to influence both dietary behavior and psychological experiences. In this respect, individuals who choose vegetarianism primarily for ethical reasons often develop stronger negative attitudes toward meat consumption, largely due to concerns about animal welfare and the perceived link between meat production and animal suffering [151]. Consequently, ethical vegetarians tend to exclude a broader range of animal-derived foods and are more likely to adhere to stricter dietary patterns than those motivated predominantly by health or environmental considerations [151]. This may be partly explained through the lens of intrinsic and extrinsic motivation theory: intrinsically motivated behaviors (i.e., driven by a particular personal interest) tend to foster greater consistency and commitment to an activity, whereas extrinsically motivated behaviors (i.e., driven by external rewards or pressures) may result comparatively in lower adherence and engagement [152]. Indeed, Cruwys et al. [153] reported that vegetarians and vegans perceived fewer barriers to maintaining their dietary patterns than individuals following gluten-free, paleo, or weight-loss diets. Furthermore, both vegetarian and vegan participants demonstrated higher levels of dietary adherence than the comparison groups. These findings suggest that identification with a vegetarian or a vegan community might provide a pivotal psychosocial reinforcement, strengthening commitment to the dietary pattern and facilitating its long-term maintenance. In turn, the adoption of a vegetarian diet may also be interpreted through the lens of Maslow's hierarchy of needs, particularly the need for belonging, which serves as a salient motivator for dietary choices [154]. This dimension of belonging encompasses the cultivation and maintenance of social connections characterized by acceptance and mutual recognition, thereby enhancing perceived security and reinforcing the sense of being valued within a social group [155]. At the same time, individuals might be more inclined to adopt and maintain dietary practices that facilitate alignment with valued social groups. Thus, vegetarianism extends beyond mere dietary behavior and involves a powerful motivational component for its adoption, as it represents a broader lifestyle and an expression of a worldview closely associated with sustainability, ethical concerns, and health consciousness. In fact, communities of vegetarians and vegans frequently engage in forums, discussion groups, and social networks, sharing experiences, recipes, and advice. These social spaces may act as additional motivational resources by providing encouragement, validation, and opportunities to reinforce diet-related goals. Indeed, participation in these social spaces has been shown to fulfill the intrinsic human need for belonging while fostering relationships

with like-minded individuals [156]. Therefore, it is plausible that the value congruence and social connectedness of vegetarianism may reinforce adherence to the diet and may also contribute positively to individuals' overall QoL.

As just noted, one of the primary motivations driving individuals to adopt a vegetarian diet is frequently grounded in ethical and moral convictions, which reflect respect and empathy toward animals [157]. Many individuals perceive the consumption of animal products as ethically problematic, and consequently, abstaining from such foods may facilitate a heightened sense of psychological well-being. For this reason, vegetarianism could foster positive cognitive and emotional states, including altruism, purposefulness, and moral satisfaction. For instance, Antonetti and Maklan [158] indicated that experiences of guilt or pride could shape consumer behavior and intentions toward more sustainable choices, suggesting that similar emotional mechanisms may underpin dietary decisions. Specifically, guilt associated with meat consumption may act as a catalyst for behavioral change, prompting individuals to transition to a vegetarian diet, whereas pride derived from adherence to plant-based practices may reinforce continued commitment. In addition, the pursuit of meaning in life and the degree of engagement with religious practices can shape lifestyle behaviors, including dietary patterns [159]. For instance, individuals whose faiths advocate abstention from animal products may experience psychosocial reinforcement when adhering to a vegetarian diet, which aligns with their core beliefs. In this respect, elevated levels of spirituality and religiosity have been consistently associated with enhanced outcomes across psychosocial and environmental domains of QoL, suggesting that these factors may serve as important determinants of both diet adoption and sustained adherence [159]. However, a range of barriers for adopting a vegetarian dietary pattern can also be identified, including concerns regarding its nutritional adequacy, perceived cost, unfamiliarity, inconvenience, limited knowledge of meat-free eating practices, anticipated social stigma, the cultural normalization of meat consumption, family and social influences, restricted dining options, and perceptions that vegetarian diets may be less enjoyable or satisfying that diets containing meat [160–163]. These obstacles are often particularly pronounced among men, for whom meat is frequently associated with strength, muscularity, and traditional notions of masculinity. In fact, this dynamic was evident in a study of Norwegian soldiers assessing the reception of the "Meatless Monday" program, which highlighted resistance to reducing meat consumption due to entrenched gendered perceptions [161]. These barriers are intrinsically linked to the social environment, reflecting the context in which individuals make dietary decisions. In addition, the psychological impact of encountering such barriers can be substantial. Schmitt et al. [164] have noted that perceived discrimination, whether targeted at an individual or group, can negatively affect overall well-being, manifesting as psychological stress, anxiety, or depression. Moreover, these experiences may extend into other aspects of life, influencing self-esteem and overall life satisfaction [164]. Thus, psychosocial barriers and experiences of discrimination may undermine individual well-being and also hinder the adoption and long-term maintenance of vegetarian dietary patterns.

5.3.2. Social Influences and Stigma

As discussed earlier, vegetarianism may function as a social identity. Unlike many other dietary patterns, vegetarianism reflects an individual's sense of belonging to a group that shares common values, beliefs, and behavioral norms. Evidence from a study involving young vegan women demonstrated that participants strongly identified with their dietary choices and expressed a deep commitment to the broader "vegan lifestyle" [165]. This identification was associated with several positive outcomes, including the development of meaningful social relationships and integration into a supportive vegan community [165].

Consequently, adherence to a vegetarian diet may facilitate connections with individuals who share similar ethical, environmental, or health-related values, thereby strengthening social support networks and fostering a greater sense of belonging [166]. However, a substantial proportion of individuals who adopt a vegetarian diet might encounter social stigmatization, which could manifest as peer rejection, stereotyping, or overt discrimination. This phenomenon, commonly referred to as "vegaphobia" or "veganophobia", has been increasingly recognized as a barrier to the adoption and maintenance of plant-based diets, with evidence suggesting that attitudes toward vegetarianism are strongly influenced by the surrounding social environment [167]. One plausible explanation for this discrimination lies in the concept of cognitive dissonance. Cognitive dissonance may arise when individuals experience a conflict between their ethical or emotional concerns for animals and their continued consumption of meat, a concept commonly referred to as the "meat paradox" [168]. To alleviate this psychological tension and the moral discomfort associated with it, meat-eaters may adopt a range of cognitive and behavioral strategies, including the justification of meat consumption, the denial of animal suffering, or the expression of negative attitudes toward vegetarians and vegans. Thus, such acts of discrimination may not stem from inherent hostility or aversion to vegetarians, but rather serve as a symbolic assertion that eating meat remains a socially and morally acceptable choice.

To avoid social conflict or discomfort, many individuals following vegetarian diets may choose not to openly disclose their dietary preferences. In fact, social factors may play a pivotal role in shaping the experiences and behaviors of vegetarians, as one of the main reasons vegetarians temporarily deviate from their dietary pattern might not be a genuine desire to eat animal products, but rather the social pressure exerted by family members, friends, or colleagues [169]. Indeed, temporary departures from vegetarian practices may arise from concerns about appearing impolite, violating cultural or family traditions, creating a negative impression, or becoming the target of social stigma. In turn meat-eating individuals cohabitating with or closely connected to vegetarians may experience increased exposure to plant-based eating practices, which could foster greater acceptance of vegetarianism. These considerations further support the notion that vegetarianism functions as a social identity that both influences and is influenced by the social context in which individuals operate. In this respect, the social challenges associated with this identity might be particularly pronounced among vegans. Compared with vegetarians, vegans are more likely to experience social rejection and to be evaluated negatively by omnivorous individuals [151]. Negative perceptions of veganism are not limited to interpersonal interactions but may also be reinforced through media representations. For instance, Cole and Morgan [170] analyzed portrayals of veganism in UK newspapers and found that media coverage frequently framed vegans in a negative manner, often depicting them as overly emotional, radical, or extreme. In addition, veganism was commonly portrayed as impractical or incompatible with everyday life, and in some instances was openly ridiculed. From a psychosocial perspective, this repeated exposure to negative portrayals may foster appraisals of self-devaluation and unfair social judgement, potentially resulting in an emotional response of humiliation that has been linked to a range of adverse outcomes, such as diminished social well-being, feelings of helplessness, and avoidant tendencies [171]. Furthermore, such unfounded representations may contribute to the persistence of stereotypes surrounding veganism and reinforce the social barriers faced by individuals who adopt this potentially beneficial dietary pattern.

5.3.3. Sociocultural Determinants of Meat Consumption

Cultural context plays a pivotal role in determining which animal species are considered acceptable for human consumption. Attitudes toward the edibility of specific

animals differ substantially across societies, with certain species deemed appropriate in some countries but regarded as unacceptable or taboo in others. Ruby and Heine [172] found that disgust at the prospect of consuming certain animals is strongly shaped by perceived animal intelligence and appearance, with these factors being particularly influential in individualistic cultures such as the United States and Canada. In contrast, in more collectivist societies such as China and India, social influence, reflected in the frequency with which friends and family consume these animals, seems to play a stronger role in shaping willingness to eat them. Research also indicates that the strategies used to resolve cognitive dissonance arising from the "meat paradox" may differ across cultural contexts, as making the animal origin of meat more salient can reduce willingness to consume meat and promote psychological distancing from food animals through diminished mind attribution [173]. Thus, culturally mediated factors might shape individual decisions regarding which animals are consumed, highlighting the interplay between social values, morality, and dietary choices.

Gender differences may also play a role in shaping attitudes toward the consumption or avoidance of animal-derived products. Across a variety of cultural contexts, meat consumption is frequently associated with masculinity and perceived as a symbol of strength, dominance, and control over other species. This association is particularly evident in societies where meat is culturally framed as an appropriate or even preferred food for men [151,161]. Indeed, men's higher meat consumption and resistance to reducing it can be attributed to adherence to traditional masculine norms, with many perceiving abstaining from meat as "unmanly", a phenomenon often referred to as the "masculinity dilemma". In this respect, conformity to traditional masculine norms, including stoicism, competitiveness, sexual virility, and self-reliance, is pervasive across cultures and contexts, particularly in Western societies, and consistently predicts higher meat consumption and lower willingness to adopt vegetarian diets, whereas adherence to non-traditional masculine norms is associated with reduced meat intake, highlighting the influence of masculinity ideologies on men's dietary choices [169,174]. In addition, specific masculine norms related to toughness, social status, emotional restraint, and heterosexuality, appear to reinforce meat consumption, whereas non-traditional norms emphasizing authenticity, empathy, health consciousness, nurturing roles, and the questioning of conventional gender expectations may facilitate greater openness toward vegetarian diets and reductions in meat intake [174]. In coherent alignment with these insights, women are more likely to perceive meat consumption as environmentally detrimental and to view vegetarian diets as both health-promoting and viable alternatives [175]. Large epidemiological studies, including the EPIC-Oxford cohort [176] and the Adventist Health Study 2 [177], reflect these patterns, reporting a higher proportion of female participants among vegetarians (78% and 65%, respectively). Moreover, a cross-cultural study involving countries with high beef consumption such as Argentina, Brazil, the United States, and France, found that men reported higher beef consumption frequency and greater perceived palatability, whereas women more often associated red meat consumption with negative emotions such as disgust [178]. This study also identified cross-national variation in attitudes toward vegetarianism: American women expressed the highest levels of admiration for vegetarian practices, whereas French women showed the lowest. Furthermore, attitudes toward beef consumption varied across countries, with participants from Brazil and Argentina reporting more favorable perceptions compared with those from France and the United States [178].

5.3.4. Mental Health Outcomes

Concerns have been raised regarding the possible relationship between vegetarian diets and mental health disorders. However, the available evidence remains largely incon-

clusive, with studies reporting heterogeneous findings. Some investigations have suggested that vegetarian dietary patterns may be associated with improved psychological well-being and a lower prevalence of depressive symptoms. For instance, Jin et al. [179] reported an inverse association between adherence to vegetarian diets and depression among middle-aged South Asian adults living in the United States. Similarly, a meta-analysis published in 2016 found that higher consumption of fruits and vegetables was associated with a reduced risk of depression, highlighting the potential role of plant-derived foods in supporting mental health [180]. Additional evidence comes from a retrospective cohort study based on data from the Chinese Longitudinal Health and Longevity Survey, which followed 1666 adults aged over 65 years between 2008 and 2018 [181]. The study examined the relationship between plant-based dietary patterns and the longitudinal progression of depressive symptoms, revealing that adherence to a healthy plant-based diet was associated with a lower likelihood of unfavorable depressive trajectories. In contrast, diets characterized by a high intake of unhealthy plant-derived foods were linked to a worsening of depressive symptoms over time. These findings suggest that the mental health effects of vegetarian diets may depend on the exclusion of animal products but also on the overall nutritional quality of the dietary pattern adopted [181].

Nevertheless, research has also linked vegetarian dietary patterns with a higher prevalence of depressive symptoms. For instance, a study conducted in the United Kingdom identified a positive association between vegetarianism and depression among men, even after adjustment for potential confounders, including sociodemographic characteristics and nutritional status [182]. Similarly, Lavallee et al. [183] investigated the relationship between vegetarian diets and mental health across representative population samples from Germany, Russia, and the United States, as well as student populations in China and Germany. Increased levels of anxiety and depression were observed only among Chinese participants. However, the magnitude of this association was modest, with vegetarian dietary habits accounting for approximately 1% of the variance in depressive and anxiety symptoms. The authors also noted that motivations for adopting vegetarianism differed substantially among populations, with Chinese students being more strongly influenced by cultural and economic considerations than by ethical or health-related factors [183]. Consistent with these findings, a study involving older Chinese adults reported a positive association between plant-based dietary patterns and depression, although this relationship was observed exclusively in men [184]. Further complexity is added by evidence suggesting that the association may vary according to the type of vegetarian diet adopted. In a cross-sectional analysis of a French cohort, Matta et al. [185] found that depressive symptoms were positively associated with pescatarian and lacto-ovo-vegetarian dietary patterns, whereas no significant association was observed among vegans. This finding may challenge the assumption that greater dietary restriction necessarily corresponds to poorer mental health outcomes. The authors proposed that differences in motivations and lifestyle characteristics among vegans may partly explain this discrepancy. Interestingly, the study also identified a positive relationship between depressive symptoms and the number of food categories excluded from the diet, suggesting that dietary restriction itself, rather than vegetarianism per se, could contribute to the associations observed in some studies [185]. The direction of causality remains another important unresolved issue. Michalak et al. [186] reported a positive association between vegetarian diets and mental disorders during the previous 12 months. However, temporal analyses indicated that psychiatric conditions often preceded the adoption of vegetarian dietary patterns. These findings may raise the possibility that individuals experiencing mental health issues may be more likely to modify their diets, rather than vegetarianism being a direct cause of mental health disorders [186]. Potential biological mechanisms underlying both beneficial and

adverse effects have also been proposed. Medawar et al. [187] emphasized that, despite the well-established physical health benefits of vegetarian diets, their influence on mental health remains insufficiently understood. On one hand, inadequate intake of nutrients such as vitamin B12 could negatively affect neurological function and psychological well-being. On the other hand, vegetarian diets may support mental health through favorable modulation of the GM and the gut–brain axis, mechanisms increasingly recognized as important regulators of cognitive and emotional processes [187]. The uncertainty surrounding this topic is reflected in a recent umbrella review synthesizing evidence from nine systematic reviews examining the relationship between dietary patterns and depression [188]. Among the included reviews, four suggested that plant-predominant diets were associated with greater depressive symptoms, whereas the remaining studies reported either conflicting findings or no significant associations. Therefore, the current body of evidence does not allow definitive conclusions regarding the relationship between vegetarian dietary patterns and mental health. Considerable methodological heterogeneity, including differences in study design, dietary classification, population characteristics, and control of confounding variables, likely contributes to the inconsistent findings reported to date [11].

5.3.5. A Potential Link Between Meat Consumption and Systemic Violence

The widespread normalization of using animals as food can diminish sensitivity to violence, potentially promoting a cultural environment in which aggressive behaviors are more easily tolerated. Repeated exposure to animal suffering in conventional farming practices has been shown to reduce empathy and emotional responsiveness, strengthening societal acceptance of harm and connecting attitudes toward animals with a broader permissiveness toward violence, an effect intensified by the systemic nature of industrial agriculture [189]. Historically, this phenomenon has been compounded by the progressive weakening of legal protections for farmed animals: initially among the first to receive anti-cruelty coverage, these animals were gradually exempted from legislation, allowing standard agricultural procedures to escape scrutiny. As production shifted from small-scale family farms to large corporate enterprises, this legal void facilitated the institutionalization of suffering at an unprecedented scale, described by some scholars as a crisis of animal exploitation on par with other mass social harms [190].

The link between violence toward animals and humans has been recognized, with animal abuse serving as a strong, although not absolute, predictor of aggression toward others [191]. Indeed, individuals who engage in cruelty toward animals are more likely to demonstrate violent behaviors toward humans, highlighting a psychological connection between these forms of harm. Evidence indicates that certain public mass shooters and active offenders have histories of animal abuse, and such individuals tend to be younger, less likely to die at the scene, and more prone to harming multiple victims [192]. Similarly, in domestic abuse contexts, perpetrators often target companion animals as a means of psychological control, reinforcing abusive environments and influencing victims' choices to remain in these situations [193]. Employment in slaughterhouses has also been consistently linked to adverse psychosocial outcomes, with workers exhibiting elevated rates of depression, anxiety, antisocial behavior, sexual offenses, and attitudes that condone violence compared with other populations [194].

Considering that large-scale animal domestication and exploitation is interrelated with systemic violence, social oppression, zoonotic outbreaks, resource depletion, population displacement, and contributions to global crises such as hunger, environmental degradation, and climate change [195], it is reasonable to suggest that exposure to mass animal slaughter shapes moral and social attitudes, particularly among youth. Childhood and adolescence are formative periods for social and moral development, during which ethical

frameworks, behavioral norms, and values are established and often remain resistant to change. In this respect, normalized exposure to cruelty against animals may exacerbate harassment dynamics, fostering aggressive and desensitized behaviors and creating a social environment in which both general bullying and specific forms such as ethnic-cultural bullying are more likely. The latter involves the marginalization of peers based on perceived racial or cultural differences [196], a process closely linked to cognitive and affective mechanisms of dehumanization. By analogy, routine exposure to animal cruelty may reinforce the perception of human out-group members as less morally significant, thereby amplifying interethnic aggression. Consequently, the societal acceptance of violence against animals is not only an ethical issue regarding nonhuman beings but also a contributing factor to the socialization of violence and dehumanization among young people, with important implications for educational policy and school-based interventions. Given these considerations, highly influential environments (e.g., family, schools, universities) represent pivotal opportunities for promoting more equitable social values, particularly regarding attitudes toward animals [8]. Indeed, integrating ethical education, reflection on dietary practices, and awareness of the impacts of animal exploitation may allow interventions during key developmental periods to counteract desensitization and normalized violence. In this context, promoting the adoption of vegetarian dietary patterns can challenge ingrained cultural norms that sustain cruelty, fostering empathy and reducing the societal acceptance of violence in its various forms [8]. Thus, vegetarianism may function as a potential form of moral engagement against the normalization of avoidable harm, encouraging more critical attitudes toward other forms of exploitation, exclusion, and inequality.

5.4. Environmental Insights into Vegetarian Diets

The environment in which an individual is embedded represents a key determinant of QoL, with factors such as personal safety, access to healthcare and social care services, transportation infrastructure, and opportunities for recreation and leisure potentially playing a role. In this context, environmental stressors such as pollution and climate change constitute important threats to well-being and can substantially impair QoL across diverse domains [197]. From this perspective, vegetarian diets might constitute key components of a socioecological transition, with their potential contribution to environmental sustainability highly depending on the organization of food systems, agricultural practices, market structures, and policy frameworks.

5.4.1. Food System Impacts

As previously stated, adopting more sustainable dietary patterns (i.e., vegetarian and vegan diets) has been associated with a diminishment in environmental degradation, thereby supporting broader determinants of planetary health and overall well-being. Diets based on plant-based foods generally require fewer natural resources and generate a lower environmental burden compared with animal-based dietary patterns, largely due to reduced land use, water consumption, and input requirements across the food production chain [61]. Quantitatively, omnivorous dietary patterns have been estimated to require substantially greater resource inputs, including approximately 2.9-fold higher water use, 2.5-fold higher energy demand, 13-fold higher fertilizer use, and 1.4-fold higher pesticide use compared with vegetarian dietary patterns [198]. In parallel, animal agriculture accounts for a disproportionate share of environmental pressures, contributing a large fraction of food-related GHGEs and occupying the majority of global agricultural land, while also exerting considerable demand on freshwater resources [18]. Within this framework, vegan dietary patterns tend to represent the lowest environmental burden, particularly when based on minimally processed, regionally sourced plant foods and limited reliance on ultra-

processed meat analogues. Lacto-ovo-vegetarian diets, although still substantially more sustainable than omnivorous patterns, generally exhibit higher environmental footprints than vegan diets, largely driven by dairy production systems. Indeed, a notable proportion of GHGEs associated with lacto-ovo-vegetarian dietary patterns has been attributed to dairy consumption [18].

In general, plant-based foods exhibit relatively high energy efficiency, as foods richer in protein tend to deliver more protein per unit of energy input, reflecting a greater nutritional return for the energy invested in their production. This implies that protein-dense plant foods can supply substantial amounts of protein with comparatively lower environmental and energetic costs. By contrast, this correlation does not hold for foods of animal origin, which are characterized by markedly higher energy requirements. For these foods, an increase in protein content is typically associated with a decrease in energy efficiency, meaning that achieving higher protein yields demands disproportionately greater energy inputs [199,200]. This distinction underscores the potential of plant-based proteins as more sustainable sources of dietary protein, both in terms of resource use and environmental impact.

Aleksandrowicz et al. [16] evaluated dietary transitions in which animal-based foods were progressively reduced or fully replaced by alternative dietary patterns, including vegetarian, vegan, Mediterranean, and pescatarian diets. Their analysis suggests that shifting from a typical Western dietary pattern toward more plant-forward eating could yield substantial environmental benefits, with potential reductions of approximately 50% in water use and up to 80% in both GHGEs and land-use demands associated with food production. Similar conclusions were reported by Rosi et al. [37], who found that vegetarian dietary patterns, including lacto-ovo-vegetarian and vegan variants, consistently exhibited lower environmental impacts across multiple indicators, including carbon emissions, water consumption, and land occupation. Extending these findings to a global scale, Springmann et al. [41] estimated that dietary shifts away from animal-derived foods toward plant-based alternatives in high-income settings could simultaneously deliver substantial co-benefits for planetary and human health, including reductions of up to 84% in food-related GHGEs and decreases of up to 12% in premature mortality. Collectively, these insights highlight that dietary change represents a highly impactful lever for environmental mitigation while also offering measurable public health gains, particularly when aligned with broader sustainability-oriented food system reforms. Importantly, environmental concerns have emerged as a key driver behind the adoption of vegetarian diets and the reduction in meat consumption. From a sustainability perspective, a diet should preserve biodiversity and ecosystem integrity, while being affordable and causing minimal environmental footprint [201]. Interest in sustainability and environmental responsibility has been associated with the adoption of vegetarian diets, as individuals may experience an enhanced sense of meaning and life purpose, which can, in turn, reinforce dietary adherence and improve overall QoL [202].

5.4.2. Structural Determinants

In addition to personal choices, economic determinants also shape the adoption of vegetarian dietary patterns. Indeed, both macroeconomic conditions, reflected in a country's overall economic status, and individual-level factors, such as income and social class, could influence dietary behavior. In this context, as income decreases, the proportion of household expenditure allocated to food increases, making individuals more sensitive to price fluctuations. Conversely, those with higher incomes tend to experience less impact from food costs and demonstrate greater selectivity in food purchases. In economically less developed regions, food prices exert a particularly strong influence on consumption

patterns, a relationship that is less pronounced in wealthier countries [203]. Economic factors also impact diet quality: while increased income has been positively associated with higher fruit consumption, it may simultaneously drive higher expenditures on dining out, processed foods, and meat, while potentially reducing legume intake [203]. In turn, a cross-sectional study in the United States found that lower-income populations exhibited lower overall diet quality, characterized by decreased fruit and vegetable consumption along with higher intake of sugar-sweetened beverages and frozen desserts [204]. These findings underscore the complexity of economic influences on dietary choices, highlighting the need to consider both affordability and accessibility when evaluating factors that shape adherence to vegetarian diets. Therefore, the economic context represents a key determinant in the adoption of vegetarian diets and the reduction in meat consumption. The price of animal-derived foods can directly shape consumer behavior, with higher costs often leading to decreased intake. For instance, a Canadian study reported that increases in meat prices caused 37.9% of participants to reduce or eliminate their meat consumption. However, despite these price-driven behavioral changes, meat remains deeply embedded within certain regional culinary traditions (e.g., Argentina, Brazil, the United States), and is often assigned a higher cultural and symbolic value than other food groups. As a result, cultural attachment may act as a substantial barrier that moderates or even counterbalances the influence of economic constraints on dietary change [205]. In line with this, evidence from the Australian context indicates that price increases can significantly reduce meat consumption, with economic considerations emerging as a stronger motivator than health, ethical, religious, or environmental concerns [206]. Thus, understanding the economic environment is essential for interpreting dietary behavior and for identifying effective levers to promote reductions in meat intake and potential transitions toward vegetarian diets. In addition, the feasibility of reducing meat consumption is closely linked to affordability and also to the availability and accessibility of diverse plant-based food options, which are themselves influenced by broader economic structures and food system inequalities.

An additional factor that may hinder the adoption of a nutritionally adequate vegetarian diet relates to the logistics of procuring fresh fruits and vegetables. These perishable foods require frequent shopping and appropriate storage to minimize spoilage, unlike meat and other products that are often frozen and have longer shelf lives. Consequently, consumption of fresh produce can be constrained by time limitations and inadequate storage facilities, which may also increase costs. Limited access to fresh foods has been shown to negatively affect consumption, particularly among low-income populations [207]. Educational attainment may also play a pivotal role in dietary choices. Higher levels of education have been positively associated with the adoption of vegetarian diets, whereas lower educational levels may act as a barrier [176]. These observations suggest that public health initiatives that provide accessible educational materials on healthy and cost-effective dietary choices could enhance the adoption of vegetarian diets [8]. In parallel, public policies aimed at reducing the cost and improving access to fruits, vegetables, and other plant-based foods could simultaneously encourage the consumption of more plant-forward diets and support reductions in meat intake [208].

6. Discussion

This narrative review provided a multidimensional perspective on vegetarianism as a phenomenon with unique potential to facilitate food-system transformation, as its adoption often reflects ethical commitments and psychosocial implications that extend beyond a simple dietary choice, while also offering potential benefits for both human health and environmental sustainability. Based on the evidence examined and discussed, several key considerations and future directions can be outlined.

6.1. Addressing the "Meat Paradox"

One of the most important barriers to dietary transition might be the persistence of the so-called "meat paradox" (i.e., the psychological conflict that arises when individuals simultaneously care about animal welfare while continuing to consume animal products). This dissonance is commonly resolved through a range of cognitive strategies, including minimizing animal suffering, denying complex mental capacities to animals, emphasizing the necessity of meat consumption, or psychologically distancing animals from the products derived from them. As a consequence, the "meat paradox" hinders the adoption of plant-based diets and also contributes to the social resistance often encountered by vegetarians and vegans.

Beyond its dietary implications, the "meat paradox" raises important ethical questions regarding human relationships with other living beings. Historically, one of the most common justifications for animal consumption has been the assumption that non-human animals possess lower levels of consciousness or subjective experience than humans. However, evidence suggests that many species exhibit complex cognitive abilities, emotional capacities, and forms of conscious awareness [209]. Although important differences between species undoubtedly exist, the growing recognition of animal sentience challenges simplistic distinctions that have traditionally been used to justify differential moral consideration. A related argument concerns the capacity to suffer: while the subjective experience of suffering cannot be directly measured across species, evidence indicates that injury detection, nociception, pain-related neural mechanisms, and protective behavioral responses are evolutionarily conserved across a wide range of animals [210]. Indeed, mammals, birds, and numerous aquatic species possess sophisticated nociceptive systems that share important functional similarities with those of humans. In this context, whether humans experience uniquely intense or prolonged forms of affective suffering remains an open scientific question. However, future research examining biological and behavioral signatures of pain across species may provide valuable insights into the evolutionary origins of suffering and its moral relevance.

Among the various strategies used to resolve the "meat paradox", one of the most common, and arguably one of the most ethically incoherent, is the belief that individual responsibility is irrelevant because the animal has already been slaughtered. In other words, the rationalization encountered among omnivorous populations is the claim that individual abstention from meat is inconsequential, because "if I don't eat it, someone else will" or "the animal is already dead." At first glance, this argument appears to absolve personal responsibility, suggesting that consumption choices are morally neutral when considered in aggregate. However, this line of reasoning is deeply flawed on multiple levels. It ignores the cumulative impact of individual behaviors in shaping demand, production practices, and social norms. In turn, dietary choices are not isolated acts but participate in the economic and cultural system that perpetuates animal exploitation. Moreover, the assertion that the animal "is already dead" reduces sentient beings to inert objects and denies the ethical significance of their lives and welfare prior to death. This logic also conflates with inevitability of moral justification: even if another person consumes the animal, the ethical responsibility to minimize harm remains intact, as moral obligations are not contingent on collective complicity. In essence, such rationalizations reflect a form of cognitive dissonance and moral disengagement that mirrors the mechanisms underpinning the "meat paradox", reinforcing the normalization of cruelty and undermining the ethical and psychological foundation for adopting plant-based diets.

Another frequent justification for meat consumption is the belief that it is either natural or biologically necessary. In many high-income societies, food availability is abundant and well-planned vegetarian and vegan diets can adequately support health

across the lifespan. Moreover, the production systems responsible for the majority of contemporary meat consumption differ substantially from the evolutionary environments often invoked in appeals to naturalness, relying instead on highly industrialized practices, intensive breeding, and large-scale technological intervention. Consequently, contemporary meat consumption may be shaped less by biological necessity than by cultural traditions, social norms, convenience, and sensory preferences. Finally, the "meat paradox" is often maintained through psychological distancing mechanisms that transform living animals into abstract food commodities. Such processes reduce emotional engagement with the individual animal and facilitate the moral disengagement required for routine consumption. In fact, these mechanisms reflect a worldview in which humans position themselves above other species and assign moral value according to perceived utility or superiority. From this perspective, fostering greater recognition of animal welfare and moral consideration may represent an opportunity to cultivate empathy, reduce the normalization of violence, and promote more compassionate forms of coexistence [8]. Future educational, scientific, and policy initiatives should therefore explore strategies capable of reducing the psychological barriers associated with the "meat paradox" while encouraging more reflective and ethically informed dietary choices.

6.2. Overcoming "Vegaphobia"

Vegetarianism appears to function as a social identity that can foster belonging, social support, and community integration. As vegetarian and vegan diets have become increasingly visible and socially accepted in many societies, negative attitudes toward these groups appear to be progressively decreasing. Nevertheless, forms of stigma or resistance may persist in specific cultural, social, or geographical contexts. For instance, in contexts where meat consumption is strongly associated with cultural identity, tradition, or social practices, vegetarian choices may face greater resistance due to cultural expectations and perceived deviations from established norms. In addition, stigma may occur through subtle forms of social pressure, including mocking behaviors or stereotypes that portray vegetarian individuals as impractical or nutritionally inadequate (e.g., questioning what vegetarians eat or making comments that trivialize their dietary choices). Similarly, geographical differences may influence these attitudes, with vegetarian individuals potentially encountering greater social challenges in rural areas or regions where livestock production and meat-based traditions represent important components of local economies. In this context, vegetarians and particularly vegans may still experience stigma and discrimination, driven in part by social norms. These dynamics can influence both dietary adherence and psychosocial well-being, highlighting the relevance of the environment in shaping vegetarian experiences. Importantly, "vegaphobia" may reflect certain mechanisms through which societies respond to value-based minority groups: individuals challenging established norms might be portrayed as unrealistic, radical, or socially disruptive. In this respect, vegetarianism may be socially framed as an implicit criticism of conventional lifestyles. Thus, resistance toward vegetarians may arise from disagreement with dietary practices themselves and also from the perceived threat they pose to prevailing cultural traditions, social identities, and established systems of consumption, with media representations and public discourse further contributing to this phenomenon.

The persistence of "vegaphobia" in certain contexts raises important questions regarding social tolerance and pluralism. In current democratic societies, diversity is generally regarded as a desirable value when applied to ethnicity, religion, gender, or political beliefs. However, dietary diversity is often granted less legitimacy despite being similarly linked to personal values, moral convictions, and cultural identities. This discrepancy suggests that some forms of difference remain more socially acceptable than others, particularly

when they challenge deeply ingrained consumption practices. For instance, in Spain's public education systems, religious pluralism has received increased attention, with emphasis on approaches aimed at facilitating its implementation, including dietary changes or abstentions [211]. However, when dietary choice is free, such as vegetarianism, there are generally no specific protocols aimed at promoting the inclusion of these individuals or families, and the widely held notion that one must eat everything, including meat and fish, to be healthy continues to be taught in some classroom contexts. Paradoxically, while vegetarians should be able to choose their dietary patterns without social pressure or discrimination, it is actually those who choose to eat meat, especially when they do so excessively, who could arguably be subject to comparatively greater social pressure and scrutiny due to the sustainability and ethical implications associated with dietary patterns based on animal product consumption. Therefore, it is essential to create environments where vegetarian and vegan options are normalized, respected, and promoted for greater future adoption in the interest of animal welfare, planetary integrity, and social development. In this respect, research should seek to identify the underlying determinants of "vegaphobia", with particular attention to understanding how educational systems, media narratives, family environments, and cultural norms shape attitudes toward vegetarianism. Ultimately, interventions aimed at increasing food literacy and reducing dietary stereotypes may represent promising strategies for fostering inclusive social environments, tolerating diversity, evaluating current dietary patterns, and engaging constructively with ethical and environmental challenges. Future efforts should thus focus on facilitating the integration of vegetarian and vegan choices through evidence-based communication and practices across social institutions and communities.

6.3. Balancing the Diet–Environment–Health Trilemma

Sustainable diets still remain as an emerging field, necessitating extensive research to define optimal dietary patterns according to the geographic context. GHGEs serve as a widely accepted proxy for environmental impact due to their strong correlation with energy use, water consumption, land utilization, water eutrophication, nitrogen release, and air acidification [212]. However, a comprehensive evaluation of dietary sustainability requires the consideration of additional environmental dimensions, including ozone layer depletion, biodiversity loss, soil and water degradation, chemical pollution (e.g., pesticide and fertilizer runoff), marine ecosystem impacts, waste generation, and climate change. In recent years, the adoption of vegetarian diets has gained prominence as a sustainable strategy that might promote environmental preservation. Plant-based proteins provide high nutritional returns with lower resource demands compared with animal-based foods. In addition, extensive evidence suggests that these diets may be associated with reductions in GHGEs, land use, and biodiversity loss, although their impacts on water and energy use may vary according to the foods consumed. Moreover, this dietary transition may also reinforce sustainability-oriented values among populations, promoting adherence and contributing to overall QoL. Thus, vegetarianism might play a central role in reducing the environmental footprint of food systems, but its sustainability should not be assumed a priori. Further research is still needed to identify an optimal plant-based dietary pattern across diverse agricultural contexts. To this end, it will be necessary to integrate robust ecological, nutritional, and socio-economic evidence. Structural factors may play a major role in this context, with food prices, income, accessibility, education, and food-system inequalities facilitating or hindering dietary transition.

Regarding health outcomes, well-planned vegetarian and vegan diets may confer substantial benefits through multiple interconnected mechanisms, including favorable modulation of the GM, reduced inflammation and oxidative stress, improved cardiometabolic

health, and lower risk of several chronic diseases. Indeed, adherence to vegetarian dietary patterns has been associated with a reduced risk of multiple chronic diseases, including cancer, obesity, T2D, dyslipidemia, hypertension, MetS, and vascular disorders. However, these potential advantages must be considered along with important nutritional and lifestyle factors, as inadequate dietary planning may increase the risk of specific nutrient deficiencies and related adverse health outcomes, particularly in vulnerable populations such as infants, children, and pregnant or lactating women [23].

Balancing the diet–environment–health trilemma involves major challenges. One of then lies in moving beyond reductionist approaches that focus on isolated nutrients, single environmental indicators, or individual consumer choices. Future efforts should prioritize the development of integrated food-system frameworks capable of simultaneously accounting for nutritional adequacy, environmental performance, affordability, cultural acceptability, and long-term feasibility. In practical terms, the most effective strategy may not necessarily involve achieving universal adherence to a single dietary model, but rather promoting flexible plant-based dietary patterns adapted to local ecological and sociocultural contexts. For instance, increasing the consumption of legumes, whole grains, fruits, vegetables, nuts, and seeds while progressively reducing the intake of resource-intensive animal products could represent a realistic and scalable pathway in many settings. At the same time, policy interventions should extend beyond consumer education and address structural determinants of food choice, including agricultural subsidies, food pricing systems, institutional food procurement, urban food environments, and nutritional literacy. Ultimately, the success of future dietary transitions will depend on identifying what constitutes an optimal diet and on creating social, economic, and political conditions that make sustainable and health-promoting choices accessible, attractive, and achievable for diverse populations.

In the context of the diet–environment–health trilemma, one of the greatest limitations might be the tendency to frame dietary change primarily as an individual responsibility. Although personal choices undoubtedly matter (i.e., selfishness is rampant and individual responsibility is conspicuously absent), food consumption occurs within environments shaped by economic incentives, cultural traditions, marketing practices, and political decisions. Consequently, expecting large-scale dietary transitions without transforming the systems that influence food choices may be unrealistic. Future research should therefore focus on understanding how social norms, institutional structures, and economic policies can facilitate the widespread adoption of optimal dietary patterns. In this respect, it is plausible that, at present, vegetarian and vegan patterns are the ones that best fit this optimum. Thus, the transition toward more plant-based food systems should be viewed as a societal transformation requiring coordinated action across public health, agriculture, education, and environmental governance sectors.

6.4. Shaping the Future of Plant-Based Foods

Building on the current evidence, the trajectory of plant-based foods is poised to become both a structural necessity and a strategic lever to address global food security, climate mitigation, and population health. While innovations such as biomass fermentation, precision processing, and novel protein sources like algae, fungi, and adapted legumes are promising, the ultimate challenge lies in aligning technological progress with equitable access and cultural adoption. Instead mimicking animal-based products, plant-based foods must prioritize functionality, nutrient density, and culinary versatility. Personalized nutrition, guided by omics sciences, offers unprecedented potential to customize plant-based diets to individual metabolic and genetic profiles, although the risk of creating disparities between populations with varying access to such technologies must be indeed

addressed. Furthermore, the development of plant-based foods should explicitly integrate holistic health objectives, such as enhancing GM diversity, reducing chronic disease risk, and supporting longevity, while minimizing reliance on ultra-processed formulations that could undermine these benefits. In practical terms, achieving a balance between innovation, sustainability, and health could involve regional sourcing of ingredients to reduce environmental footprints, fortifying foods with micronutrients commonly limited in plant-based diets, and fostering culinary education programs to increase adoption. Ultimately, the future of plant-based foods must be conceptualized as a socio-technological transformation that address ecological stewardship, nutritional adequacy, and broad-scale accessibility.

In addition to technological advances, a fundamental question concerns the ultimate objective of future plant-based food systems. Part of the current innovation in plant-based meat products is centered on reproducing the sensory characteristics of meat, particularly its color, texture, and flavor [213], implicitly assuming that contemporary dietary preferences represent the ideal endpoint of food evolution. However, this assumption deserves critical examination. Current food preferences have been shaped by cultural traditions, social norms, marketing strategies, and industrial food environments, rather than emerging solely from nutritional or ecological considerations. Consequently, the long-term success of plant-based foods may depend on their capacity to foster new culinary identities and cultural norms that are intrinsically aligned with human and planetary health. Future generations may increasingly value foods according to criteria such as sustainability, nutritional quality, ethical production, and ecological resilience, rather than their similarity to animal-based products. In this context, the most transformative innovation may not be technological but cultural: promoting greater food literacy, reconnecting consumers with food production systems, and redefining what societies perceive as desirable, aspirational, and socially normative to eat. Such a transition could facilitate a broader shift from a food system primarily driven by convenience and consumption toward one centered on long-term well-being, environmental conservation, and responsible resource use.

6.5. Alternative Paradigms for the Current Animal Product Consumption

The commercialization of animal products represents one of the most significant barriers to transitioning toward sustainable and health-promoting diets. Current market practices reveal a stark dichotomy. On the one hand, high-quality, premium animal products are positioned as luxury goods, accessible only to wealthier consumers. On the other hand, ultra-processed meat-based foods dominate fast-food chains, with marketing strategies targeting children and young adults through various persuasive approaches (e.g., toys, gamification, brand loyalty incentives). Consistent with this, evidence indicates that exposure to fast food marketing is associated with increased brand preferences and intake among youth, with social media advertising further expanding the reach of fast food companies, particularly through child-targeted content and promotional strategies across diverse socioeconomic contexts [214,215]. While both strategies perpetuate meat consumption, the latter might be particularly pernicious. By targeting formative age groups, fast-food corporations entrench consumption habits that normalize animal exploitation and compromise long-term public health. This insidious marketing exploits socio-economic vulnerabilities, manipulates cultural perceptions of "fun" and reward, and transforms ethical and environmental concerns into abstract or secondary considerations. Moreover, the economic power of these corporations allows them to influence policy, dominate public discourse, and maintain an information asymmetry that leaves consumers largely unaware of the environmental, health, and ethical consequences of their choices. To counteract these dynamics, two interrelated strategies can be proposed. First, comprehensive educational

initiatives must be prioritized. These should extend beyond basic nutritional literacy to encompass ecological literacy, ethical reasoning regarding animal welfare, and the socio-cultural mechanisms that perpetuate meat consumption. Education must equip individuals with critical thinking tools to recognize the influence of corporate messaging and to evaluate food choices in terms of sustainability and moral responsibility [8]. Public campaigns could incorporate interactive platforms, gamified educational content, and community-based workshops to engage audiences effectively, particularly youth, in ways that rival the marketing power of fast-food chains. Second, regulatory interventions targeting advertising practices are essential. Just as tobacco marketing has been regulated through warning labels, age restrictions, and limitations on promotional strategies, meat-based fast-food products should carry explicit warnings regarding health risks and ecological impacts, along with transparent disclosures about the number of animals killed for production. These interventions should be standardized globally, including online platforms, television, and point-of-sale advertising. In addition, taxation policies and subsidies could incentivize plant-based alternatives while disincentivizing ultra-processed meat consumption, thereby rebalancing the economic calculus that might favors industrial meat production.

Another consideration concerns animal-derived products that do not necessarily require the slaughter of animals for their production, such as dairy and eggs. These industries have been widely associated with concerns regarding animal welfare, which may contribute to important ethical debates [216]. However, it is plausible to argue that substantial improvements in animal welfare could be achieved through stricter regulatory frameworks, increased human oversight, and the incorporation of advanced monitoring technologies capable of continuously assessing health, behavior, stress responses, and environmental conditions. Such a transition would inevitably increase production costs, as ensuring genuinely high welfare standards requires greater space allocation, lower stocking densities, improved veterinary care, environmental enrichment, and more labor-intensive management systems. Nevertheless, this economic consequence may not necessarily be undesirable. In fact, it could be highly desirable within the context of the current landscape. Higher prices could encourage consumers to perceive dairy and egg products less as everyday commodities and more as premium goods consumed in moderation. In turn, reduced consumption combined with higher welfare standards could contribute simultaneously to lowering overall production volumes, decreasing environmental pressures, enhancing human health by addressing potential nutritional deficiencies, and improving the QoL of farmed animals. From this perspective, the future of dairy and egg production should perhaps not be framed as a choice between unrestricted consumption and complete abandonment, but rather as a transition toward systems in which animal welfare, environmental sustainability, and responsible consumption are jointly prioritized. Such an approach may represent an intermediate and socially feasible pathway capable of reducing harm while broader transformations in food systems continue to unfold.

6.6. Remaining Challenges in Plant-Based Dietary Sustainability

While vegetarian and vegan diets are increasingly recognized for their potential to mitigate environmental pressures and promote human health, several key aspects regarding their implication in these areas remain relatively unaddressed. First, the environmental benefits of plant-based diets are highly context-dependent, varying according to the specific plant foods consumed, their production methods, seasonality, and transport distances. Current research often focuses on theoretical or average dietary scenarios, ignoring the potential consequences of substituting certain high-impact animal products with resource-intensive plant foods. In this respect, environmental impacts may differ substantially among plant-based foods depending on cultivation requirements and geographical origin.

In turn, imported products may involve additional burdens associated with transportation and supply chains. Second, economic accessibility remains a major barrier: sustainable plant-based foods might be less affordable or less available to lower-income populations, potentially limiting the practical reach of dietary recommendations. Third, the rapid commercialization of plant-based products risks a proliferation of ultra-processed alternatives that, while environmentally preferable to meat in many cases, may compromise nutritional quality and long-term public health objectives. Fourth, the structural dynamics of contemporary food systems, including industrialized production, global supply chain concentration, and agricultural policies, are rarely integrated into sustainability assessments, but they significantly influence the real-world efficacy of dietary transitions. Furthermore, regional variability in life-cycle assessment studies, resulting from differences in climate, local production conditions, data availability, and methodological approaches, should be considered when interpreting environmental impacts. Addressing these gaps requires targeting both consumption and production. Individual-level dietary assessments should account for food choices, seasonality, and production sustainability. Policies must improve access to nutrient-dense, minimally processed plant foods while limiting ultra-processed alternatives. Agricultural and food system reforms should incentivize regenerative practices, support small- and medium-scale producers, and align supply chains with ecological, social, and economic sustainability. Public education should integrate environmental, nutritional, and cultural literacy to guide informed choices. Finally, research must expand beyond environmental metrics to include socioeconomic, ethical, and cultural dimensions, ensuring plant-based transitions are health-promoting, sustainable, and socially equitable.

6.7. Unresolved Questions in the Relationship Between Vegetarian Diets and Mental Health

Regarding health outcomes, it is plausible to argue that well-planned vegetarian and vegan diets that adequately meet nutritional requirements are generally more beneficial than typical Western dietary patterns. While the evidence supporting their favorable effects on cardiometabolic health and chronic disease prevention appears relatively robust, the relationship between plant-based diets and mental health remains an important unresolved question. A recent critical review examining the association between vegetarian diets and mental health outcomes concluded that the considerable divergence across findings appears to depend largely on the characteristics of the intervention, geographical context, and psychological parameters assessed [11]. Specifically, six studies reported positive associations between vegetarian diets and poorer mental health outcomes, four studies suggested the opposite relationship, and six studies found no significant effects attributable to vegetarian dietary patterns. To explain these inconsistencies, one possible hypothesis is that deficiencies in specific nutrients involved in neurotransmitter metabolism, such as methionine, tryptophan, or tyrosine, may be linked to depressive symptoms in inadequately planned vegetarian diets. However, alternative explanations suggest that the observed associations may be driven primarily by psychological rather than nutritional mechanisms. For instance, individuals experiencing mental health difficulties may be more likely to adopt vegetarian diets as a self-protective strategy due to their perception as healthier lifestyles [11]. Conversely, findings from Matta et al. [185] indicate that depression may be associated with the exclusion of any food group rather than with vegetarianism specifically, suggesting that vegetarian diets could represent only one manifestation of a broader relationship between food restriction and depressive symptoms [185]. Interestingly, the association identified by Matta et al. [185] was strongly influenced by legume consumption, becoming progressively weaker as legume intake increased. Given that legumes are rich sources of plant protein and other essential nutrients, these findings raise the possibility that nutritional adequacy might partially explain some of the inconsistencies observed across studies [11].

Nevertheless, several methodological limitations continue to undermine progress in this field, as many studies fail to specify the duration of dietary adherence, distinguish between different vegetarian dietary patterns, or adequately account for participants' motivations for adopting the diet. As a result, highly heterogeneous groups, including vegans, lacto-ovo-vegetarians, pescatarians, semi-vegetarians, and even low-frequency meat consumers, are frequently combined under the same "vegetarian" label, despite substantial differences in nutritional composition and lifestyle characteristics [11]. Additional limitations include reliance on self-reported and unverified dietary data, sampling biases, insufficient control of confounding variables, inadequate descriptive reporting, and inconsistent definitions of dietary categories. Furthermore, future studies should consider the potential influence of participants' pre-existing attitudes toward vegetarianism, as positive or negative predispositions may bias both dietary reporting and psychological outcomes. Addressing these methodological shortcomings through standardized dietary definitions, longitudinal designs, objective dietary assessment tools, and more rigorous control of confounding factors will be essential for clarifying whether plant-based diets exert independent effects on mental health or whether the observed associations primarily reflect broader psychological, behavioral, and social determinants [11]. Despite these unresolved issues regarding the relationship between vegetarian diets and mental health, current evidence suggests that plant-derived bioactive compounds and nutraceuticals may play a relevant role in mental well-being and neurological function [217]. In particular, essential fatty acids, prebiotics, phytochemicals, amino acids, vitamins, minerals, and omega-3 fatty acids have been associated with mood regulation and cognitive performance. In addition, several nutraceuticals may exert neuroprotective effects by modulating oxidative stress, neuroinflammation, mitochondrial dysfunction, and dysregulated signaling pathways, thereby potentially preventing or slowing neurodegenerative processes. Moreover, phytochemicals acting as phytopsychobiotics may influence mental health through GM modulation and the production of bioactive metabolites, with compounds such as curcumin, *Hypericum*, ginsenosides, *Ginkgo biloba* polysaccharides, and lavender essential oil showing antidepressant, neuroprotective, and neurotransmitter-regulating effects in experimental models [217]. These findings are particularly promising in the field of nutritional psychiatry, as the formulation of well-planned dietary patterns that incorporate both nutraceuticals and psychobiotics with demonstrated benefits for certain mental health conditions may open new therapeutic avenues beyond conventional pharmacological approaches [218,219]. In this context, customized plant-based diets could represent relevant models within clinical psychiatry, given their potential to provide a diverse array of bioactive compounds that may support mental health and cognitive function, while also offering benefits across other domains of health and contributing to sustainability.

In summary, the heterogeneous findings observed across studies may reflect the coexistence of multiple and potentially opposing mechanisms through which vegetarian dietary patterns could influence mental health. However, these mechanisms should be interpreted cautiously given the remaining uncertainties within this area of research. First, inadequately planned vegetarian diets may contribute to poorer mental health outcomes through insufficient intake of specific nutrients involved in neurological function and neurotransmitter metabolism (e.g., vitamin B12). Second, well-designed plant-based dietary patterns may exert beneficial mental health effects through improved nutritional quality, greater intake of bioactive compounds, and modulation of the gut–brain axis. Third, psychosocial and sociocultural factors might also play a role, as individuals with pre-existing mental health conditions may be more likely to adopt vegetarian diets in the context of lifestyle changes, while the effects of dietary restriction, motivations for dietary change, and social context may influence psychological outcomes. Moreover, reverse causality and residual

psychosocial confounding remain relevant considerations, as underlying psychological factors may influence both the adoption and maintenance of vegetarian dietary patterns. Fourth, differences in dietary patterns, including the degree of restriction and excluded food groups, may partly explain inconsistencies across studies. Finally, attitudes toward animal consumption might also represent an additional pathway influencing mental health and social behavior, including psychological desensitization to suffering, reduced empathic responsiveness, moral disengagement, and the normalization of hierarchical relationships between humans and other sentient beings.

6.8. Schools as a Strategic Setting for Promoting Plant-Based Diets

Schools represent one of the most influential environments for shaping lifelong dietary behaviors and, therefore, constitute a strategic setting for promoting plant-based dietary patterns. Beyond providing meals, educational institutions can influence food preferences, social norms, ethical reasoning, and environmental awareness during critical developmental periods. Nevertheless, evidence synthesized by Borrego-Ruiz and Borrego [8] across 28 studies from 14 countries indicates that the implementation of plant-based or healthier school meals faces multiple barriers, including children's sensory preferences, established eating habits, peer influence, limited educator and parental time, insufficient knowledge regarding sustainable food choices, financial and infrastructural constraints, cultural attachment to meat, and low family engagement. Although practical barriers such as cost, logistics, and resources are frequently emphasized, socio-cultural determinants may ultimately represent the most challenging obstacles to overcome. Dietary behaviors are deeply embedded within family traditions, cultural identities, and value systems, making them inherently resistant to change. Consequently, interventions focused exclusively on nutritional information are unlikely to achieve substantial long-term success unless they also address the broader social and cultural context in which food choices are made [8].

Despite the aforementioned, several facilitators toward the promotion of vegetarian diets can also be identified across educational settings. Experiential learning strategies, including school gardens, cooking activities, food tasting sessions, and multisensory educational approaches, appear particularly effective in fostering positive attitudes toward plant-based foods. Similarly, family and community involvement, teacher engagement, supportive social norms, nutrition education integrated into curricula, and institutional policies promoting sustainable food practices have all been associated with greater acceptance of plant-based meals [8]. Among these facilitators, family influence deserves particular attention, as dietary habits acquired during childhood are often reinforced within the household and may persist throughout adulthood. These considerations suggest that the successful promotion of plant-based diets requires a multi-level approach in which schools, families, healthcare professionals, policymakers, and local communities operate in a coordinated manner. Importantly, plant-based dietary interventions should be framed as nutritional initiatives but also as educational opportunities capable of integrating health, environmental sustainability, ethical reflection, and civic responsibility. However, the evidence remains constrained by methodological limitations, including small and non-representative samples, cross-sectional designs, short intervention periods, self-reported data, and insufficient stakeholder representation [8]. Future research should therefore prioritize large-scale longitudinal and mixed-methods investigations capable of evaluating both behavioral outcomes and the mechanisms underlying successful implementation across diverse educational contexts.

6.9. The Potential Influence of Vegetarianism on Violence Dynamics

Promoting plant-based diets during childhood may have critical implications for moral development and social behavior. Ethical reflection regarding the treatment of animals introduces opportunities to cultivate empathy, perspective-taking, and moral reasoning, capacities that are highly relevant to the prevention of aggression and violence. In contemporary societies, violence toward animals is frequently normalized through cultural traditions, industrial food systems, media representations, and commercial advertising [8]. Children are routinely exposed to contradictory messages in which animals are simultaneously portrayed as companions deserving affection and as commodities whose suffering remains largely invisible. This normalization may contribute to a broader desensitization toward harm, particularly when animal suffering is trivialized or disconnected from its ethical implications. Media exposure further complicates this landscape. For instance, animated content depicting animal-directed aggression, advertisements specifically designed to create positive emotional associations with animal-derived foods, and interactive media such as video games may all contribute to shaping attitudes toward violence and domination [220,221]. Indeed, evidence suggests that repeated exposure to violent content can reduce sensitivity toward aggression and increase its social acceptability [222]. Although caution is required when drawing direct causal conclusions on this specific topic, these considerations raise important questions regarding the messages that children internalize about power, vulnerability, and the treatment of sentient beings. Educational systems therefore have an opportunity, and even the duty, to promote media literacy, ethical reflection, and critical thinking regarding the social and commercial forces that shape dietary behaviors and attitudes toward animals. These considerations become particularly relevant when examined along with research on victimization. A recent comprehensive review [223] emphasize that self-conscious (e.g., humiliation, shame, guilt) and basic (e.g., anger, fear) emotions play a central role in bullying dynamics, with humiliation appearing especially harmful because it combines perceived injustice, self-devaluation, and the attribution of cruelty to others. Such findings further suggest that the widespread normalization of violence toward animals may contribute to a gradual desensitization of empathy among perpetrators, reducing their sensitivity to the emotional consequences of victimization. Although animal victimization and interpersonal bullying are distinct phenomena, both involve asymmetrical power relationships in which a more powerful individual or group imposes harm on a vulnerable target. Indeed, non-human animals are frequently subjected to symbolic forms of humiliation within many societies. At the linguistic level, animal-related terms are commonly employed as insults or derogatory labels (e.g., “pig”, “rat”, “bitch”, “cow”), often intended to diminish the social value or dignity of the recipient. Similarly, media representations frequently portray certain animals as unintelligent, dirty, weak, ridiculous, or inherently inferior beings, reinforcing perceptions that they deserve less moral consideration. Furthermore, industrial animal production systems routinely deprive animals of autonomy, natural behaviors, and individual identity, reducing sentient beings to economic units or commodities whose value is determined primarily by their productive function. From a psychosocial perspective, these practices may normalize attitudes that trivialize vulnerability and legitimize the degradation of others when they occupy a subordinate position. Consequently, repeated exposure to the humiliation, objectification, and instrumentalization of animals may shape attitudes toward non-human beings and also contribute to social norms that diminish empathy and facilitate the acceptance of exclusion, domination, or mistreatment in human relationships. This possibility highlights the need to consider animal welfare as an ethical issue that concerns non-human animals, thereby influencing the development of empathy, moral reasoning, and prosocial behavior within society. In fact, from the perspective of Social Learning Theory, these insights ac-

quire additional significance. Bandura proposed that individuals acquire behaviors largely through observation, imitation, and social modeling rather than exclusively through direct experience [224,225]. If children repeatedly observe the normalization of unnecessary harm toward vulnerable beings, particularly within contexts where such harm is socially rewarded, economically incentivized, or culturally celebrated, it is plausible that broader attitudes regarding domination, exploitation, and violence may also become normalized. Although animal consumption and interpersonal aggression are distinct phenomena, both involve underlying processes related to moral consideration and the perceived legitimacy of causing harm to others for personal benefit or interest. Consequently, encouraging reflection on animal welfare may indirectly contribute to fostering more compassionate and prosocial attitudes toward fellow human beings. Thus, it is plausible that the progressive adoption of plant-based diets might reduce societal violence. Building on the harmful consequences of prevailing dietary patterns for nonhuman animals, encouraging young people to question normalized forms of harm, consider the interests of vulnerable individuals, and recognize the consequences of their actions may contribute to the development of more socially responsible generations. In this sense, plant-based education could constitute a future pedagogical framework aimed at strengthening the moral and emotional foundations of a more sustainable and less violent society.

6.10. Nutritional Challenges Associated with Vegetarian Diets

Vegetarian dietary patterns vary in strictness from fully plant-exclusive to more flexible regimens including limited animal products, with adoption influenced by ethical, cultural, religious, health-related, and environmental considerations. These diets tend to be particularly higher in fiber, polyunsaturated fatty acids, vitamin E, folate, and magnesium. However, they require careful planning to ensure nutritional adequacy [226]. As previously stated, the main nutritional concerns associated with vegetarian diets relate to the potential risk of inadequate intake of vitamin B12, iron, zinc, calcium, vitamin D, iodine, and omega-3 fatty acids. It is important to acknowledge that insufficient intake of these nutrients might contribute to long-term health consequences, including anemia, impaired bone health, and neurological disorders [143]. Indeed, vitamin B12 plays a pivotal role in maintaining optimal neurological function and erythropoiesis. Deficiency of this vitamin may lead to adverse health outcomes, such as neurological alterations and anemia [145,227]. Similarly, micronutrients such as iron and zinc are essential for immune function and oxygen transport. However, unfortified plant-based sources generally exhibit lower bioavailability compared with animal-derived sources [146,228]. Calcium and vitamin D are pivotal for bone mineralization [147], and inadequate intake of these nutrients has been associated with an increased risk of long-term complications, including osteoporosis and reduced skeletal integrity [229]. In turn, iodine and omega-3 fatty acids play important roles in thyroid function and metabolic and cardiovascular health, respectively [230]. In pregnant women, inadequate intake of these nutrients may negatively affect fetal growth, birth weight, and maternal hematological status [231]. Similarly, in children, nutritional deficiencies may contribute to severe anemia, neurological impairment, reduced bone strength, delayed growth, impaired immune system development, and altered thyroid function [232]. Building on these insights, to address the potential nutritional challenges associated with plant-based diets, several strategies have been proposed [143]. These include the regular use of appropriate supplementation, particularly for nutrients such as vitamin B12 and vitamin D, as well as the consumption of fortified foods (e.g., plant-based milks and yogurts enriched with essential micronutrients). In this respect, individualized dietary planning, supported by professional guidance when necessary, may help optimize nutrient intake while addressing potential economic and regional barriers to food

accessibility. Regarding protein intake, although animal products are recognized as rich sources of high-quality protein, the adequacy of protein consumption among individuals following vegetarian or vegan diets has been extensively debated. However, Mariotti and Gardner [233] reported that protein-rich plant foods, including traditional legumes, nuts, and seeds, can provide sufficient protein to achieve adequate intake in adults following vegetarian or vegan dietary patterns. Nevertheless, a risk of inadequate protein intake may exist among a subset of vegans, particularly among individuals with low overall energy intake or limited dietary variety. For instance, in older adults, some concerns have been raised regarding the possibility that certain vegetarian dietary patterns may provide insufficient protein intake, potentially affecting long-term nitrogen balance [233]. Moreover, some vegetarian meals may contain insufficient amounts of protein and leucine, which could compromise postprandial anabolic responses. However, current evidence does not support the conclusion that vegetarian diets increase the functional risk of sarcopenia in healthy older individuals [233]. In turn, children consuming sufficient energy to support growth requirements are generally expected to achieve adequate protein intake from well-planned vegetarian diets [233]. On the other hand, in pregnant women, exclusive reliance on plant-based sources of essential amino acids may make achieving recommended targets more challenging during periods of increased physiological demand, particularly in later stages of pregnancy [231]. Overall, these considerations underscore that the nutritional adequacy of vegetarian diets depends on dietary planning, food variety, appropriate nutritional monitoring, and individual specific requirements, rather than on the exclusion of animal products itself. Therefore, while well-designed vegetarian dietary patterns might adequately support health across the lifespan, specific nutritional considerations remain essential, particularly among individuals with increased physiological requirements. Ultimately, the promise of plant-based dietary patterns lies in their potential to reshape the nexus of nutrition, environmental conservation, and societal behavior, highlighting that advancing planetary and public health requires integrating dietary quality, accessibility, and ecological awareness into a cohesive, systemic approach. Importantly, achieving this transition will require evidence-based and standardized nutritional frameworks that account for individual variability (e.g., age, physiological demands, health status, specific dietary requirements). Thus, these frameworks may facilitate the safe and sustainable adoption of plant-based dietary patterns by ensuring that the potential environmental, health, and societal benefits are not compromised by preventable nutritional inadequacies.

6.11. Limitations and Strengths of the Review

This review provides a comprehensive perspective on the role of vegetarianism in contemporary society, particularly as a potential driver of change within prevailing food systems with implications for health, environmental sustainability, ethical considerations, and broader social development. However, several limitations should be acknowledged. First, its narrative design is inherently descriptive and does not include a formal assessment of methodological quality or in-depth quantitative or qualitative synthesis of the included studies, which may limit the ability to determine the relative strength and robustness of the evidence synthesized. Second, a substantial proportion of the evidence reviewed is cross-sectional in nature, limiting causal inference. In addition, a considerable body of the examined literature is largely theoretical. Third, the broad scope adopted to capture multiple dimensions of vegetarianism precludes an in-depth examination of specific dietary subcomponents or contextual variations. Fourth, limitations within the included studies themselves, including heterogeneity in the definition and operationalization of vegetarian diets, may have influenced the interpretation of findings. Fifth, the evidence considered in this review is characterized by substantial variability in study designs, populations,

and methodologies, which may contribute to conflicting findings and complicate the interpretation of associations. Furthermore, the predominantly observational nature of much of this evidence limits the ability to fully exclude residual confounding and reverse causality. Finally, the integrative and forward-looking orientation of the review, aimed at identifying future directions, may introduce a degree of interpretative subjectivity that is not always directly supported by empirical evidence.

Despite the aforementioned limitations, the present review also presents strengths that should be considered. First, the narrative review approach enabled the examination of multiple domains related to vegetarianism, allowing the integration of a heterogeneous body of literature. Unlike approaches focused on narrowly defined questions, the methodology adopted stands out for its greater flexibility [234], facilitating the generation of new insights and interpretations. Second, this review differs from previous narrative reviews by adopting a multidimensional perspective on vegetarianism, thereby moving beyond its evaluation as a dietary pattern and considering it as a particularly complex phenomenon with important implications for human health, animal welfare, environmental sustainability, social values, and systemic factors. Third, this review provides a comprehensive conceptual framework that positions vegetarianism within the interconnected dimensions of the diet–environment–health trilemma, while incorporating psychological and societal determinants that may facilitate or hinder its adoption in the context of dietary transitions. Finally, this review addresses an important gap in the literature derived from the fragmented nature of current evidence, in which the health, planetary, ethical, and psychosocial implications of vegetarianism are often examined independently.

6.12. Future Directions and Recommendations

From an environmental perspective, vegetarian diets align with sustainable nutrition goals by lowering environmental burdens. This relationship is primarily mediated by differences in resource requirements between food groups. Compared with animal-based foods, plant-based foods generally require fewer inputs in terms of land use, water consumption, feed production, and energy expenditure, while generating lower GHGEs and reducing pressures associated with biodiversity loss and nutrient pollution. These effects can be largely explained by the lower resource conversion efficiency of animal production, as resources allocated to livestock are partially lost through metabolic processes before being converted into edible products. Consequently, dietary patterns characterized by higher proportions of plant-based foods and lower reliance on animal-derived products may modify the environmental footprint of food systems by influencing production demands, resource allocation, and associated ecological impacts. In this context, adherence to healthy dietary patterns (e.g., Mediterranean diet) has been associated with greater knowledge of sustainable food practices and more environmentally responsible dietary choices [235]. Nevertheless, population-level adherence remains low, with observed gaps between recommended planetary health diets and actual behaviors [236]. Future efforts should move beyond examining vegetarianism as an individual dietary choice and instead consider it as a complex phenomenon shaped by biological, psychological, social, cultural, economic, and environmental factors. From a research perspective, further investigations should prioritize standardized definitions of vegetarian dietary patterns, longitudinal designs, objective dietary assessment methods, and integrative approaches capable of simultaneously evaluating nutritional adequacy, health outcomes, environmental impacts, and psychosocial determinants. Importantly, attention should be given to vulnerable populations and to the development of evidence-based frameworks that allow dietary recommendations to be adapted according to individual variability, cultural context, and food accessibility. From a practical perspective, the successful implementation of plant-based dietary patterns

will require coordinated actions among healthcare professionals, educational institutions, communities, and food-system organizations. This includes improving nutritional literacy, strengthening professional training, developing accessible dietary guidance, and creating supportive environments in which sustainable and health-promoting food choices are feasible rather than merely encouraged. Importantly, the environmental sustainability of dietary transitions cannot be explained merely by individual preferences, as food choices are strongly influenced by structural conditions, including market availability (e.g., the presence of vegetarian alternatives in supermarkets, restaurants, and public food services), pricing-related factors (e.g., the relative affordability of plant-based foods compared with animal-derived products), agricultural policies (e.g., subsidies and incentives that influence food production systems), and institutional practices (e.g., procurement policies determining the availability of vegetarian meals in schools, hospitals, and other public institutions). At the policy level, future strategies should thus address the structural determinants that influence food consumption, including food accessibility, institutional procurement, agricultural practices, economic incentives, and the regulation of food environments. In this context, initiating a transition toward more sustainable dietary patterns will likely require a structural approach rather than relying exclusively on individual responsibility. Thus, activism and advocacy efforts may play a constructive role when grounded in scientific evidence, potentially contributing to cultural shifts in how societies perceive health outcomes, environmental responsibility, and the ethical dimensions of food consumption. For instance, governing bodies and community leaders could support this transition via evidence-based public education campaigns (e.g., highlighting the health, environmental, and ethical dimensions of vegetarianism), community-based food literacy programs (e.g., workshops on the planning and preparation of nutritionally adequate vegetarian meals), school-based interventions (e.g., introducing vegetarian meal options and education on plant-based nutrition, while raising awareness about the overall harmful effects of consuming animal-derived products), professional training initiatives (e.g., training healthcare and education professionals to provide evidence-based guidance on vegetarian diets), and structural policy measures (e.g., improving the accessibility, acceptance, and feasibility of sustainable dietary choices by supporting the availability of vegetarian options in public institutions, integrating sustainability and animal welfare criteria into food procurement policies, and promoting food systems that reduce unnecessary animal suffering). Ultimately, advancing toward more sustainable dietary systems will depend on the ability to integrate research, practice, and policy within a coordinated framework that supports informed, accessible, and locally adapted dietary transitions.

7. Conclusions

Vegetarianism, including vegan diets and patterns characterized by a significantly predominant consumption of plant-based products with the exclusion of meat and fish, may represent more than merely a dietary choice, as it constitutes a value-driven lifestyle with implications for health, sustainability, and social development. In the current landscape, it is thus plausible to assert that growing interest in vegetarianism is driven by three main factors: its potential contribution to multiple domains of health, its substantial potential to reduce resource use and environmental impacts, and its association with ethical and animal-related considerations. However, vegetarianism remains a complex phenomenon encompassing relevant psychosocial dimensions with important future implications. In this respect, further research is needed to clarify its potential role as a component of future development, requiring integrated educational, cultural, technological, and policy approaches that ensure equitable access to plant-based foods, foster critical reflection on animal welfare and moral responsibility, as well as support coordinated transformations

of food systems toward healthier and more environmentally sustainable societies. Ultimately, the global implementation of dietary shifts toward plant-based patterns remains anticipated but constrained, as ingrained economic and cultural interests may delay this pivotal systemic change. Therefore, until policy authorities enact substantial structural reforms and individuals actively promote this transition within their immediate social environments, the issue is likely to persist as a subject of ongoing debate and resistance against its operationalization.

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Abbreviations

The following abbreviations are used in this manuscript:

AGEs	Advanced glycation end-products
BMI	Body mass index
BW	Body weight
GHGEs	Greenhouse gas emissions
GM	Gut microbiome
HDL-C	High-density lipoprotein cholesterol
LCHF	Low-carbohydrate high-fat
LDL-C	Low-density lipoprotein cholesterol
MetS	Metabolic syndrome
QoL	Quality of life
TC	Total cholesterol
T2D	Type 2 diabetes
VaD	Vascular disease

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