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Plant-based Diet in Athletes: A Game Changer or Just a Trend?

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Abstract

Introduction: Nowadays, a plant-based diet is gaining increasing popularity. Guidance on adopting this diet can be found in scientific literature, as well as through social media and advertisements promoting a wide range of new products appearing on store shelves. By reviewing scientific sources, we decided to analyze the principles of a plant-based diet, its associated benefits, as well as the potential negative aspects of its implementation, particularly among athletes.

Aim of the study: This review aims to analyse the literature concerning the impact of a plant-based diet on accomplishments, endurance, and health, especially for athletes.

Materials and methods: The authors conducted an extensive review of available articles on PubMed, ScienceDirect, Cochrane, UpToDate, Google Scholar, and Pubmed databases, using keywords such as vegan, vegetarian, plant-based,, civilization diseases, healthy lifestyle, athletes, strength, accomplishments, endurance. Studies accessed between 2016-2024 were included in this review.

Results and conclusions: A plant-based diet is a valuable option for athletes, offering benefits such as improved recovery, reduced oxidative stress, and alignment with sustainable practices. When properly planned to address potential nutrient deficiencies, it can effectively support athletic performance, including strength and endurance, without compromising health. Thus, for athletes seeking ethical, health-conscious, or environmentally sustainable dietary patterns, a plant-based diet is indeed worth considering.

Keywords: vegan, vegetarian, plant-based, civilization diseases, healthy lifestyle, athletes accomplishments, endurance

1. Introduction

One of the primary factors motivating young men to engage in regular exercise is the desire to build muscle. This often involves adopting muscle-enhancing practices such as resistance training, increasing overall caloric intake, and consuming specific types of foods. According to the International Society of Sports Nutrition (ISSN), animal-based protein sources, such as poultry, dairy, eggs, and protein supplements, are strongly recommended for promoting muscle hypertrophy. Among gym enthusiasts, these are the predominant protein sources, while plant-based options, such as legumes, are typically consumed less frequently. Bodybuilders, in particular, tend to consume substantial amounts of dietary protein, predominantly derived from animal products. However, reliance on animal-based foods and supplements can lead to an unbalanced diet, potentially displacing nutrient-dense foods such as fruits and vegetables.

Approximately half of gym-goers report insufficient consumption of these key food groups. This trend contrasts with public health guidelines, which advocate for reducing red and processed meat consumption while increasing the intake of fruits, vegetables, and whole grains. Global recommendations similarly emphasize reducing meat consumption and incorporating more plant-based foods into the diet.[1,2]

Plant-based diets have gained recognition as effective dietary strategies for enhancing athletic performance across various forms of exercise. Their popularity is partly due to their perceived environmental sustainability and lower ecological footprint. Individuals adhering to plant-based diets often demonstrate a broader health-conscious lifestyle, encompassing behaviors such as regular physical activity, abstaining from smoking and alcohol, and maintaining consistent sleep patterns. These non-dietary factors may enhance the health benefits of plant-based eating. Adopting such diets is frequently motivated by ethical, ecological, economic, religious, or health considerations.[3]

Optimal nutrition is critical for modulating oxidative stress, and the popularity of plant-based diets among athletes is increasing.[4] An ideal diet should be well-balanced, including lean meats, nuts, fresh fruits, vegetables, and healthy fats like olive oil. Such a diet supports a healthy gut microbiome, which plays a key role in reducing inflammation and

preventing chronic disorders.[2] The vegan diet, in particular, has emerged as a popular choice globally due to concerns about health, animal welfare, and environmental sustainability. However, understanding the potential barriers, risks, and benefits of such diets is essential for informed dietary planning.[5]

Dietary choices significantly influence athletic performance, with various dietary patterns offering distinct benefits.[6] Over recent years, the adoption of plant-based diets has grown steadily, driven by factors such as improved performance, faster recovery, and broader health benefits. Although research on the impact of plant-based diets on athletic performance is still limited, the trend is notable. In the United States alone, the number of vegans has risen from approximately 0.3–0.5% of the population 25 years ago to 2.5–6 million today. Similar patterns have been observed in other regions, including the UK, Germany, and Australia, where ethical, health-related, and environmental motivations drive this shift. Evidence suggests that increased consumption of animal-based foods, particularly red and processed meats, is associated with a heightened risk of various cancers.[7]

There is also a marked increase in the consumption of plant-based foods in Western countries. [8]Surveys indicate that 12% of Europeans identify as vegetarians, with breakdowns including 35% vegans, 21% lacto-ovo vegetarians, and 44% omnivores, particularly among participants in athletic events.[9] The rising demand for plant-based diets among athletes underscores a growing trend, driven largely by ethical, health, and environmental concerns.[10]

2. Characteristics and Nutritional Composition of Plant-Based Diets

Plant-based diets focus on consuming minimally processed plant foods, including whole grains, legumes, fruits, vegetables, nuts, seeds, and non-hydrogenated vegetable oils, while reducing or excluding animal-derived products, especially red and processed meats. Variants of plant-based diets range from veganism, which strictly excludes all animal products, to vegetarian diets that may include dairy and eggs, or pescatarian diets, which incorporate fish and seafood. These diets tend to be richer in fiber, antioxidants, vitamins, minerals, and bioactive compounds such as polyphenols and carotenoids, while being lower in energy density, cholesterol, and saturated fats compared to omnivorous diets. [1–4,6]

Type of diet	Red meat	Poultry	Fish	Dairy	Eggs
Omnivorous/ Mixed	✓	✓	✓	✓	✓
Pesco-lacto-ovo vegetarian	✗	✗	✓	✓	✓
Lacto-ovo vegetarian	✗	✗	✗	✓	✓
Lacto-vegetarian	✗	✗	✗	✓	✗
Pesco-vegetarian	✗	✗	✓	✗	✗
Ovo-vegetrian	✗	✗	✗	✗	✓
Vegan	✗	✗	✗	✗	✗

Despite these benefits, plant-based diets may present certain nutritional challenges. Individuals following these diets often have lower intakes of vitamin B12, vitamin D, calcium, omega-3 fatty acids, and specific amino acids such as lysine, methionine, and leucine, which are found in higher concentrations in animal-based foods.[1,11] For vegans in particular, the absence of animal products can lead to deficiencies in these nutrients, necessitating fortified

foods or supplements to maintain optimal health. Adequate dietary planning is essential to avoid potential risks, such as increased homocysteine levels associated with vitamin B12 deficiency, which can elevate the risk of cardiovascular events like stroke.[12]

Importantly, plant-based diets are gaining recognition not only for their health benefits but also for their environmental sustainability. They align with global dietary recommendations aimed at reducing the ecological footprint of food production. By emphasizing plant foods, these diets contribute to mitigating climate change, reducing water use, and minimizing greenhouse gas emissions, making them a pivotal strategy for addressing both personal health and planetary well-being.[13]

3. Health Benefits of Plant-Based Diets

Plant-based diets offer a range of health benefits, particularly in improving metabolic markers and reducing the risk of chronic diseases. Studies have shown that these diets enhance insulin sensitivity and lower fasting insulin levels in individuals with overweight or obesity. This is particularly relevant for those at risk of type 2 diabetes, a condition characterized by elevated fasting and postprandial glucose levels due to insulin resistance. Diets emphasizing minimally processed plant foods, such as whole grains, legumes, vegetables, fruits, and seeds, and reducing consumption of red and processed meats, sodium, sugar-sweetened beverages, and refined grains, play a critical role in preventing and managing diabetes.[14,15]

Furthermore, plant-based eating patterns are associated with reduced weight gain and improved cardiovascular health in population-based studies. Animal-based diets, especially those high in processed meats, are linked to negative metabolic outcomes and increased risk of weight gain. Some of the positive effects observed in vegan diets, such as lower energy density, high antioxidant levels, and lipid-lowering properties, are also present in less restrictive vegetarian diets. Mechanistically, these benefits are attributed to factors such as reduced cholesterol intake, the presence of bioactive compounds, and the high fiber content of plant-based foods, which collectively improve lipid profiles and glycemic control.[12,14]

These dietary patterns also provide protection against oxidative stress by counteracting harmful reactive oxygen species, reducing systemic inflammation, and protecting cells from free radical damage.[4] Clinical studies have demonstrated their effectiveness in lowering all-cause mortality, reducing ischemic heart disease (IHD) risk, and decreasing the need for medications in individuals with cardiovascular disease. Such findings underscore the potential

of plant-based diets to serve as a comprehensive approach to chronic disease prevention and management.[5,16]

4. Protective Effects Against Specific Diseases and Broader Implications

The protective effects of plant-based diets extend beyond metabolic and cardiovascular health to include a reduced risk of certain cancers.[5,17,18] These diets, which are rich in dietary fiber, antioxidants, and bioactive plant compounds, have been shown to lower the risk of digestive system cancers, particularly colorectal, rectal, and pancreatic cancers. Unlike diets high in red and processed meats, which are associated with a heightened risk of such cancers, plant-based diets play a preventative role. Interestingly, no significant differences have been observed between vegan and other plant-based diets in terms of their cancer-protective effects.[19]

Moreover, plant-based diets contribute to improved gastrointestinal health by promoting a healthier gut microbiota. The high intake of dietary fiber typical of these diets supports digestive function and reduces the risk of diverticular disease and other gastrointestinal disorders. However, certain limitations of plant-based diets, such as lower intakes of essential nutrients like calcium and omega-3 fatty acids, highlight the need for careful dietary planning to avoid potential adverse effects, such as weakened bone health or cognitive issues.[12,20]

In the context of sustainability, plant-based diets align with global efforts to reduce the environmental impact of food choices. By shifting away from resource-intensive animal-based foods, these diets not only improve individual health outcomes but also address broader challenges related to climate change, resource depletion, and food security.[2] Their adoption has been shown to lower greenhouse gas emissions and reduce the ecological footprint of food production, making them an integral part of sustainable dietary guidelines. Collectively, the health and environmental benefits of plant-based diets position them as a key strategy for achieving long-term public health and ecological goals.[17]

5. Vegan Diet and Its Impact on Insulin Sensitivity and Cholesterol Levels

Recent studies have highlighted that a vegan diet can enhance insulin sensitivity, reduce levels of low-density lipoprotein (LDL) cholesterol, and lower total cholesterol, thus contributing to improved metabolic health. Furthermore, this dietary pattern is associated with better body weight management and reduced levels of C-reactive protein (CRP), a marker of inflammation. These changes are significant in mitigating the risk of cardiovascular diseases

and metabolic disorders such as type 2 diabetes. Research also indicates that individuals following a vegan diet experience notable reductions in body weight and HbA1c levels, further supporting the potential for veganism to aid in long-term weight and glucose control.[5,14,21]

6. Nutritional Benefits and Potential Deficiencies

While a vegan diet provides a wide range of beneficial nutrients, such as fiber, antioxidants, and phytonutrients, it also presents challenges regarding specific micronutrient intake. Common deficiencies in vegan diets include vitamin B12, iron, calcium, vitamin D, omega-3 fatty acids, and zinc. These nutrients are crucial for various bodily functions, including immune health, bone integrity, and muscle maintenance. The absence of animal-derived foods like meat, eggs, and dairy makes it harder to meet the daily requirements for these nutrients, potentially leading to issues such as anemia, bone fractures, and neurological problems. In particular, non-heme iron from plant sources is less bioavailable, and zinc absorption can be hindered by the presence of phytic acid in legumes and grains.[2,5–7,22]

7. Impact of Vegan Diet on Chronic Disease Prevention

Adopting a vegan diet has been shown to reduce the risk of several chronic conditions, including cardiovascular disease, hypertension, and certain types of cancer. This diet, rich in fruits, vegetables, legumes, and whole grains, is associated with a lower intake of saturated fat, dietary cholesterol, and processed meats, all of which contribute to a decreased risk of atherosclerosis and other cardiovascular diseases. Additionally, the high fiber content of a vegan diet aids in regulating blood glucose levels, improving glycemic control, and reducing the risk of type 2 diabetes. The presence of bioactive compounds such as flavonoids and carotenoids further supports these health benefits, with antioxidants playing a key role in reducing inflammation and protecting against oxidative stress.[2,5,10,21]

8. Mental Health and Nutritional Considerations for Vegans

While the vegan diet is widely recognized for its positive effects on physical health, it is also associated with an increased risk of certain mental health issues, including higher rates of depression and anxiety. Research suggests that deficiencies in key nutrients such as vitamin B12, zinc, and omega-3 fatty acids may contribute to these mental health challenges, as they are vital for neurotransmitter synthesis and brain function. Vegans, particularly those who

consume limited amounts of nuts, seeds, and legumes, may also experience lower leucine levels, which can impair muscle protein synthesis and overall muscle function. Therefore, ensuring adequate intake of these nutrients is essential to prevent cognitive decline and mental health issues, especially for individuals with restricted diets.[2,5,6,23]

9. Risks and Challenges of a Poorly Balanced Vegan Diet

Despite the numerous health benefits, a poorly planned vegan diet can lead to nutritional deficiencies that negatively impact overall health. Insufficient intake of essential vitamins and minerals, including vitamin B12, iron, and calcium, can result in conditions like anemia, bone loss, and immune dysfunction. Additionally, the low intake of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) from plant foods may impair cardiovascular health and reduce the anti-inflammatory effects of the diet. The overconsumption of processed vegan foods, such as meat and dairy substitutes, which may be high in sugars, salt, and unhealthy fats, can further exacerbate these risks. Ensuring a well-balanced diet with sufficient intake of key nutrients is critical to minimizing these potential health concerns and supporting long-term well-being.[2,5,22]

10. Vegetarian diet

Vegetarianism can both affect and be affected by various aspects of quality of life. The decision to adopt this dietary pattern often leads to positive outcomes, such as improved physical health, a sense of moral satisfaction, a stronger feeling of connection to the vegetarian community, and a reduced environmental impact. However, factors outside an individual's control, such as the surrounding environment, social or cultural group affiliations, gender differences, economic factors, and limited access to a diverse range of plant-based foods, may also present challenges or negative aspects associated with this lifestyle choice.[24]

11. Guidelines and Obstacles to Adopting a Vegan Diet

Dietary guidelines in countries such as the UK, Australia, and Belgium suggest that a well-planned vegan diet can meet all nutritional needs when properly balanced. A varied selection of plant-based foods, when combined with adequate caloric intake, provides essential nutrients for vegans. For adults aged 18 to 60, daily energy intake should range from 23–27 kcal/kg, while for individuals over 60, it should be 19–22 kcal/kg. It is recommended to consume at least 400g of fruits and vegetables per day (excluding starchy varieties). Dietary

fat should constitute less than 30% of total energy, with saturated fats kept under 10% and trans fats under 1%. Protein should make up around 15% of total energy, and sugar and salt intake should be limited. Nutrients such as vitamin B12 and D, which are often deficient in vegan diets, can be obtained through fortified foods or supplements. EPA/DHA supplementation (e.g., algal oil) is also recommended. A properly planned vegan diet that includes these fortified foods or supplements can adequately meet all nutrient requirements.[5,6]

Adopting and maintaining a vegan diet, however, presents several challenges. A common obstacle is a lack of knowledge regarding nutrition and supplementation, which can complicate meal planning. Vegan diets often require more time and effort to prepare compared to conventional diets, and some individuals may find plant-based foods unappealing or monotonous. While plant-based meat substitutes are available, many are ultra-processed, which is associated with higher risks of obesity and chronic diseases. Moreover, individuals accustomed to meat may find it difficult to adjust to a plant-based lifestyle. The higher cost and limited availability of fresh plant-based products can also be significant barriers. Social pressures, particularly from family and friends, can complicate the transition, as some individuals fear judgment or ostracism for their dietary choices. This can result in conflicts, especially in families where animal products are a staple. Mental health concerns have also been raised, with some studies suggesting higher rates of depression and anxiety among those on vegan diets, although the evidence remains inconclusive. Additionally, women on vegan diets may be more prone to developing disordered eating behaviors.[2,5]

Another important concern with vegan diets is the potential risk of malnutrition, particularly if key nutrients are not included. Special care is needed to ensure adequate intake of essential vitamins and minerals, such as vitamin B12, calcium, vitamin D, iron, zinc, and omega-3 fatty acids. Pregnant and breastfeeding women following a vegan diet should be particularly cautious, as deficiencies in these nutrients can negatively affect fetal and child development. Proper supplementation and careful meal planning are crucial in preventing nutritional deficiencies that could lead to complications during pregnancy or childhood.[5,7,22]

Despite these challenges, many individuals are able to maintain a vegan diet long-term, benefiting from improved health, ethical satisfaction, and environmental sustainability. Understanding the barriers and benefits of vegan diets is essential for healthcare professionals, policymakers, and the general population. By addressing potential obstacles and promoting plant-based eating, greater acceptance and adherence to vegan diets can be fostered. Clinicians and dietitians play a vital role in supporting individuals by offering proper

education, guidance, and supplementation, ensuring that all nutritional needs are met and deficiencies are prevented.[5]

To minimize the risk of deficiencies, individuals following a vegan diet should adopt specific strategies, such as choosing appropriate cooking methods and pairing foods to complement each other's nutrient profiles. Regular consultations with healthcare professionals or dietitians trained in nutrition can help prevent deficiencies early and mitigate any potential health impacts. In cases where nutrient intake is insufficient, oral supplements, especially fortified foods, are recommended to restore adequate levels of key nutrients such as protein, omega-3 fatty acids, iron, vitamin D, calcium, zinc, iodine, and vitamin B1.[10,22]

12. Impact of Plant-Based Diets on Athletic Performance

Despite growing awareness of the health benefits and potential for athletic performance enhancement, athletes are often cautioned that plant-based diets require careful planning to ensure adequate nutrient intake. The effectiveness of commonly consumed plant-based diets for maximizing muscle hypertrophy remains uncertain. Model nutrient intake recommendations suggest 1.8g of protein per kilogram of body weight per day and 2.75g of leucine per meal to support optimal muscle growth, strength, and muscle protein synthesis. These values exceed the average requirements for muscle mass gains, and daily intake for most micronutrients (with the exception of vitamin D) also surpasses general recommendations. Consuming larger portions of typical plant-based diets, scaled to meet the energy demands for maximum muscle mass and strength, fulfills protein and leucine requirements without additional planning. While plant-based diets, including vegetarian and vegan options, have historically been perceived as inadequate for athletic performance due to low protein content, current studies do not show deficiencies in total protein, lysine, methionine, leucine, or other key micronutrients for athletes. In fact, these diets are suitable for athletes when properly planned.[1,6,8,25]

13. Effects of Plant-Based Diets on Aerobic and Strength Performance

Studies indicate that plant-based diets have a moderate but positive effect on aerobic performance, with no negative effects on strength or power performance. Analysis of both aerobic and strength/power exercises reveals that overall athletic performance remains unchanged on a plant-based diet. However, a slight reduction in body mass index (BMI) has been observed. Plant-based diets do not impair strength/power performance, and they may

assist with aerobic performance. For example, vegan athletes show improvements in VO2 max during aerobic tests. Studies comparing vegetarians and omnivores in strength and power exercises have found no significant differences in performance outcomes. In endurance sports, plant-based diets have been linked to positive effects such as increased submaximal endurance and enhanced relative VO2 max.[3,6–8,26,27]

14. Antioxidant Status and Endurance in Plant-Based Athletes

Following a plant-based diet may improve an athlete's antioxidant status, which is particularly beneficial for endurance athletes engaged in high-intensity exercises like sprints, jumps, and direction changes. These activities can increase oxidative stress, and a diet rich in antioxidants, such as those found in plant-based foods, can counteract this. As plant-based diets grow in popularity among athletes, including vegan and semi-vegetarian (flexitarian) diets, they are seen as a means to improve health and athletic performance, particularly by reducing oxidative stress and inflammation. Athletes in endurance sports rely on a steady intake of carbohydrates, which are abundant in plant-based diets, to replenish glycogen stores. The combination of high carbohydrates, antioxidants, and phytochemicals supports endurance performance and overall recovery.[4,6,8,28–32]

15. Nutrient Considerations for Athletes on Plant-Based Diets

While a well-planned vegetarian or vegan diet can provide the necessary nutrients for athletic performance, it is crucial to monitor the intake of certain micronutrients, including vitamin B12, iron, zinc, calcium, and vitamin D. These nutrients are vital for athlete health, and deficiencies can negatively impact performance and recovery. For example, plant-based sources of iron have lower bioavailability compared to animal-derived iron, which can lead to fatigue and impaired endurance. Additionally, plant proteins, such as those from soy and legumes, may have a lower amino acid profile compared to animal proteins, potentially affecting muscle protein synthesis. However, with proper dietary planning and supplementation (e.g., B12 and creatine), athletes can avoid deficiencies and support optimal performance. The risk of nutrient deficiencies can be minimized through careful food selection and guidance from nutrition experts.[6,7,25,29,30,33]

16. The Viability of Plant-Based Diets for Athletes

There is no conclusive evidence to suggest that plant-based diets are inferior to omnivorous diets in terms of athletic performance. Athletes following vegetarian and vegan diets show similar performance outcomes in strength, endurance, and power exercises when compared to their omnivorous counterparts.[34]Although plant-based diets may require more attention to ensure sufficient nutrient intake, particularly protein and micronutrients, they can support muscle hypertrophy, aerobic capacity, and overall athletic performance. Additionally, the environmental and ethical benefits of plant-based diets further enhance their appeal to athletes. With proper dietary planning and supplementation, athletes can thrive on plant-based diets without compromising their performance or health.[6–9,28,33,35–37]

17. Plant-based food guide for athletes

The VegPlate for Sports, a practical vegetarian food guide, meets the essential criteria for a well-balanced diet tailored to athletes' needs. This diet incorporates a broad spectrum of plant-based foods, including grains, legumes, vegetables, fruits, nuts, seeds, and plant-derived fats, which offer optimal sources of omega-3 fatty acids such as flaxseeds, chia seeds, and walnuts. Additionally, it ensures the inclusion of reliable calcium sources while emphasizing the importance of vitamins B12 and D. Dairy products and eggs are optional, depending on the individual's choice, to achieve nutritional adequacy. The core VegPlate consists of six food groups—grains, protein-rich foods, vegetables, fruits, nuts and seeds, and fats—which must be consumed in quantities sufficient to meet an athlete's nutritional demands. For complete nutritional adequacy, it also highlights the importance of calcium- and omega-3-rich foods, as well as adequate intake of vitamin B12 and D. The recommended caloric intake ranges from 1,800 to 3,200 kcal, depending on body weight (50 to 90 kg).[9]

Optimal vegan sports nutrition requires careful planning and evaluation, considering an athlete's personal goals, training methods, preferences, and specific needs. Providing appropriate nutrition for athletes following a vegan diet is complex, as it requires addressing the unique demands based on athlete type, activity level, and individual characteristics. Despite the challenges, a vegan diet does not compromise overall energy intake, though it does alter the macronutrient distribution. Specifically, total carbohydrate and fat intake are generally sufficient, but the diet's high carbohydrate nature may limit the flexibility to adjust macronutrient proportions. Special attention is required to ensure adequate protein intake, as insufficient protein—especially from plant-based sources—may hinder both acute muscle protein turnover and long-term adaptations.[35]

Meeting elevated protein needs on a vegan diet is possible, but careful attention to high-quality protein sources is essential. Further research into non-animal-derived proteins is necessary to determine the optimal doses and strategies for supplementation to maximize performance adaptations. Vegan diets tend to lack ergogenic compounds such as creatine, carnitine, and carnosine, which are found in higher concentrations in animal-based foods. Although evidence is limited regarding the impact of these lower concentrations on performance, supplementation with these compounds may be beneficial for vegan athletes. Moreover, vegan athletes are at increased risk for micronutrient deficiencies, which could be exacerbated by dietary restrictions. Regular monitoring of micronutrient status is recommended, and any deficiencies should be addressed through fortified foods or supplements.[35]

Supplementation with creatine and beta-alanine may be particularly advantageous for vegan athletes, given that vegetarian diets often result in lower muscle creatine and carnosine levels. Although vegan diets typically provide fewer calories, protein, fat, vitamin B12, omega-3 fats, calcium, and iodine than omnivorous diets, they tend to be higher in carbohydrates, fiber, micronutrients, phytochemicals, and antioxidants. Achieving a high energy intake on a vegan diet can be challenging due to the satiating nature of plant-based foods. However, with careful food selection and management, and by ensuring the appropriate balance of energy, macronutrients, and micronutrients through both food choices and supplements, a vegan diet can fully meet the nutritional needs of most athletes.[38]

Well-structured vegetarian diets can support adequate nutrient intake throughout the entire life cycle, including for athletes, provided that specific considerations regarding nutrient sources and supplementation are addressed.[39]

Conclusions

Plant-based diets have emerged as a viable nutritional approach for athletes, offering numerous health benefits and aligning with sustainability goals. These diets, when appropriately planned, can meet the nutritional demands of athletic populations, including requirements for macronutrients, vitamins, and minerals. Despite the challenges associated with potential deficiencies in nutrients such as vitamin B12, iron, and omega-3 fatty acids, these risks can be effectively mitigated through dietary planning, fortified foods, and supplementation.

Evidence suggests that plant-based diets may enhance certain aspects of athletic performance, particularly aerobic capacity, while having no detrimental impact on strength or power. Additionally, the antioxidant and anti-inflammatory properties inherent to such diets contribute to improved recovery and reduced oxidative stress, which are critical for endurance sports.

However, the dietary strategies necessitate individualized planning to accommodate the unique requirements of different sports, training regimens, and personal health goals. Adequate intake of high-quality plant proteins and careful attention to bioavailability of critical nutrients remain central to the successful implementation of a plant-based diet for athletes.

In conclusion, while plant-based dietary patterns are not inferior to omnivorous diets in terms of supporting athletic performance and overall health, their adoption demands a proactive approach to nutritional education and careful monitoring to maximize their benefits and minimize risks. Further research into optimizing plant-based nutrition for diverse athletic disciplines is warranted to provide more robust and specific recommendations.

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References

1. Goldman DM, Warbeck CB, Karlsen MC. Completely Plant-Based Diets That Meet Energy Requirements for Resistance Training Can Supply Enough Protein and Leucine to Maximize

Hypertrophy and Strength in Male Bodybuilders: A Modeling Study. *Nutrients*. 2024;16(8). doi:10.3390/nu16081122

2. Bali A, Naik R. The Impact of a Vegan Diet on Many Aspects of Health: The Overlooked Side of Veganism. *Cureus*. Published online February 18, 2023. doi:10.7759/cureus.35148
3. Damasceno YO, Leitão CVFS, De Oliveira GM, et al. Plant-based diets benefit aerobic performance and do not compromise strength/power performance: a systematic review and meta-analysis. *British Journal of Nutrition*. 2024;131(5):829-840. doi:10.1017/S0007114523002258
4. Zare M, Shoaei N, Karimian J, et al. Effect of a plant-based diet on oxidative stress biomarkers in male footballers. *Sci Rep*. 2024;14(1). doi:10.1038/s41598-024-54198-3
5. Łuszczki E, Boakye F, Zielińska M, et al. Vegan diet: nutritional components, implementation, and effects on adults' health. *Front Nutr*. 2023;10. doi:10.3389/fnut.2023.1294497
6. Kaufman M, Nguyen C, Shetty M, Oppezzo M, Barrack M, Fredericson M. Popular Dietary Trends' Impact on Athletic Performance: A Critical Analysis Review. *Nutrients*. 2023;15(16). doi:10.3390/nu15163511
7. Isenmann E, Eggers L, Havers T, Schalla J, Lesch A, Geisler S. Change to a Plant-Based Diet Has No Effect on Strength Performance in Trained Persons in the First 8 Weeks—A 16-Week Controlled Pilot Study. *Int J Environ Res Public Health*. 2023;20(3). doi:10.3390/ijerph20031856
8. Hernández-Lougedo J, Maté-Muñoz JL, García-Fernández P, Úbeda-D'Ocasar E, Hervás-Pérez JP, Pedauyé-Rueda B. The Relationship between Vegetarian Diet and Sports Performance: A Systematic Review. *Nutrients*. 2023;15(21). doi:10.3390/nu15214703
9. Baroni L, Pelosi E, Giampieri F, Battino M. The VegPlate for Sports: A Plant-Based Food Guide for Athletes. *Nutrients*. 2023;15(7). doi:10.3390/nu15071746
10. Marrone G, Guerriero C, Palazzetti D, et al. Vegan diet health benefits in metabolic syndrome. *Nutrients*. 2021;13(3):1-24. doi:10.3390/nu13030817
11. Pinckaers PJM, Trommelen J, Snijders T, van Loon LJC. The Anabolic Response to Plant-Based Protein Ingestion. *Sports Medicine*. 2021;51:59-74. doi:10.1007/s40279-021-01540-8
12. Key TJ, Papier K, Tong TY. Plant-based diets and long-term health: findings from the EPIC-Oxford study. *Proceedings of the Nutrition Society*. 2022;81(2):190-198. doi:10.1017/S0029665121003748
13. Craig WJ, Mangels AR, Fresán U, et al. The safe and effective use of plant-based diets with guidelines for health professionals. *Nutrients*. 2021;13(11). doi:10.3390/nu13114144

14. Termannsen AD, Søndergaard CS, Færch K, Andersen TH, Raben A, Quist JS. Effects of Plant-Based Diets on Markers of Insulin Sensitivity: A Systematic Review and Meta-Analysis of Randomised Controlled Trials. *Nutrients*. 2024;16(13). doi:10.3390/nu16132110
15. Chen Z, Zuurmond MG, van der Schaft N, et al. Plant versus animal based diets and insulin resistance, prediabetes and type 2 diabetes: the Rotterdam Study. *Eur J Epidemiol*. 2018;33(9):883-893. doi:10.1007/s10654-018-0414-8
16. Salehin S, Rasmussen P, Mai S, et al. Plant Based Diet and Its Effect on Cardiovascular Disease. *Int J Environ Res Public Health*. 2023;20(4). doi:10.3390/ijerph20043337
17. Trautwein EA, McKay S. The role of specific components of a plant-based diet in management of dyslipidemia and the impact on cardiovascular risk. *Nutrients*. 2020;12(9):1-21. doi:10.3390/nu12092671
18. Baden MY, Liu G, Satija A, et al. Changes in Plant-Based Diet Quality and Total and Cause-Specific Mortality. *Circulation*. 2019;140(12):979-991. doi:10.1161/CIRCULATIONAHA.119.041014
19. Zhao Y, Zhan J, Wang Y, Wang D. The Relationship Between Plant-Based Diet and Risk of Digestive System Cancers: A Meta-Analysis Based on 3,059,009 Subjects. *Front Public Health*. 2022;10. doi:10.3389/fpubh.2022.892153
20. Hevia-Larraín V, Gualano B, Longobardi I, et al. High-Protein Plant-Based Diet Versus a Protein-Matched Omnivorous Diet to Support Resistance Training Adaptations: A Comparison Between Habitual Vegans and Omnivores. *Sports Medicine*. 2021;51(6):1317-1330. doi:10.1007/s40279-021-01434-9
21. Kahleova H, Petersen KF, Shulman GI, et al. Effect of a Low-Fat Vegan Diet on Body Weight, Insulin Sensitivity, Postprandial Metabolism, and Intramyocellular and Hepatocellular Lipid Levels in Overweight Adults: A Randomized Clinical Trial. *JAMA Netw Open*. 2020;3(11):E2025454. doi:10.1001/jamanetworkopen.2020.25454
22. Bakaloudi DR, Halloran A, Rippin HL, et al. Intake and adequacy of the vegan diet. A systematic review of the evidence. *Clinical Nutrition*. 2021;40(5):3503-3521. doi:10.1016/j.clnu.2020.11.035
23. Domić J, Grootswagers P, Van Loon LJC, De Groot LCPGM. Perspective: Vegan Diets for Older Adults? A Perspective On the Potential Impact On Muscle Mass and Strength. *Advances in Nutrition*. 2022;13(3):712-725. doi:10.1093/advances/nmac009

24. Hargreaves SM, Raposo A, Saraiva A, Zandonadi RP. Vegetarian diet: An overview through the perspective of quality of life domains. *Int J Environ Res Public Health*. 2021;18(8). doi:10.3390/ijerph18084067
25. Shaw KA, Zello GA, Rodgers CD, Warkentin TD, Baerwald AR, Chilibeck PD. Benefits of a plant-based diet and considerations for the athlete. *Eur J Appl Physiol*. 2022;122(5):1163-1178. doi:10.1007/s00421-022-04902-w
26. Durkalec-Michalski K, Domagalski A, Główka N, Kamińska J, Szymczak D, Podgórski T. Effect of a Four-Week Vegan Diet on Performance, Training Efficiency and Blood Biochemical Indices in CrossFit-Trained Participants. *Nutrients*. 2022;14(4). doi:10.3390/nu14040894
27. Craddock JC, Probst YC, Peoples GE. Vegetarian and omnivorous nutrition-comparing physical performance. *Int J Sport Nutr Exerc Metab*. 2016;26(3):212-220. doi:10.1123/ijsnem.2015-0231
28. Monteyne AJ, Coelho MOC, Murton AJ, et al. Vegan and Omnivorous High Protein Diets Support Comparable Daily Myofibrillar Protein Synthesis Rates and Skeletal Muscle Hypertrophy in Young Adults. *Journal of Nutrition*. 2023;153(6):1680-1695. doi:10.1016/j.tjnut.2023.02.023
29. Roberts AK, Busque V, Robinson JL, Landry MJ, Gardner CD. SWAP-MEAT Athlete (study with appetizing plant-food, meat eating alternatives trial) – investigating the impact of three different diets on recreational athletic performance: a randomized crossover trial. *Nutr J*. 2022;21(1). doi:10.1186/s12937-022-00820-x
30. Devrim-Lanpir A, Hill L, Knechtle B. Efficacy of popular diets applied by endurance athletes on sports performance: beneficial or detrimental? A narrative review. *Nutrients*. 2021;13(2):1-40. doi:10.3390/nu13020491
31. Barnard ND, Goldman DM, Loomis JF, et al. Plant-based diets for cardiovascular safety and performance in endurance sports. *Nutrients*. 2019;11(1). doi:10.3390/nu11010130
32. Domínguez R, Cuenca E, Maté-Muñoz JL, et al. Effects of beetroot juice supplementation on cardiorespiratory endurance in athletes. A systematic review. *Nutrients*. 2017;9(1). doi:10.3390/nu9010043
33. Pohl A, Schünemann F, Bersiner K, Gehlert S. The impact of vegan and vegetarian diets on physical performance and molecular signaling in skeletal muscle. *Nutrients*. 2021;13(11). doi:10.3390/nu13113884

34. van der Horst H, Sällylä A, Michielsen Y. Game changers for meat and masculinity? Male athletes' perspectives on mixed and plant-based diets. *Appetite*. 2023;187. doi:10.1016/j.appet.2023.106585
35. West S, Monteyne AJ, van der Heijden I, Stephens FB, Wall BT. Nutritional Considerations for the Vegan Athlete. *Advances in Nutrition*. 2023;14(4):774-795. doi:10.1016/j.advnut.2023.04.012
36. Nebl J, Haufe S, Eigendorf J, Wasserfurth P, Tegtbur U, Hahn A. Exercise capacity of vegan, lacto-ovo-vegetarian and omnivorous recreational runners. *J Int Soc Sports Nutr*. 2019;16(1). doi:10.1186/s12970-019-0289-4
37. Lynch H, Johnston C, Wharton C. Plant-based diets: Considerations for environmental impact, protein quality, and exercise performance. *Nutrients*. 2018;10(12). doi:10.3390/nu10121841
38. Rogerson D. Vegan diets: Practical advice for athletes and exercisers. *J Int Soc Sports Nutr*. 2017;14(1). doi:10.1186/s12970-017-0192-9
39. Melina V, Craig W, Levin S. Position of the Academy of Nutrition and Dietetics: Vegetarian Diets. *J Acad Nutr Diet*. 2016;116(12):1970-1980. doi:10.1016/j.jand.2016.09.025