Article

Vegetarian Diets and Athletic Performance: Nutritional Strategies and Health Implications

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Vegetarian Diets and Athletic Performance: Nutritional Strategies and Health Implications

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Abstract

The increasing adoption of vegetarian diets among athletes has sparked interest in their impact on sports performance and overall health. This review synthesizes current research to evaluate the efficacy of vegetarian diets in supporting athletic performance, focusing on macronutrient profiles, micronutrient considerations, and health benefits. Vegetarian diets, characterized by high carbohydrate content and lower protein and micronutrient bioavailability, can adequately support endurance and strength performance when well-planned. Studies indicate no significant differences in key performance metrics, such as VO2 max and muscle strength, between vegetarian and non-vegetarian athletes. However, challenges such as potential deficiencies in protein, iron, zinc, vitamin B12, and omega-3 fatty acids necessitate careful dietary planning and supplementation. Vegetarian diets offer health benefits, including reduced risks of cardiovascular disease and improved antioxidant status, which may enhance recovery and longevity. Non-vegetarian diets provide readily bioavailable nutrients like creatine and heme iron, supporting muscle repair and energy production. This review underscores the importance of personalized nutrition plans, guided by professionals, to optimize performance and mitigate deficiencies in vegetarian athletes. Further research is needed to explore long-term effects and refine strategies for nutrient adequacy in plant-based athletic diets.

Keywords: vegetarian diet; athletic performance; plant-based nutrition; macronutrients; micronutrient deficiencies; endurance performance; strength training; nutritional planning; antioxidant status and non-vegetarian diet

Introduction

The pursuit of a healthy lifestyle through consistent exercise and dietary advice has grown in recent years. People who choose to eat a vegetarian diet do so because of its advantages, which include lower blood cholesterol, a lower risk of prostate and large intestine cancer, fewer deaths from heart attacks and heart diseases in general, and a decrease in obesity and related diseases (Ferreira, Burini, Maia, 2006). Vegetarians avoid foods derived from animals, as demonstrated by their high intake of carbohydrates, fiber, magnesium, potassium, folate, and antioxidants. They may also be deficient in calcium, zinc, iron, cobalamin, and essential amino acids and fatty acids. In relation to performance in strength activities, researches indicate that vegetarians and non-vegetarians show similar aerobic performance.

Therefore, as long as the vegetarian diet is carefully managed to prevent nutritional deficits, it may coexist with athletic participation (Hall, 2014). It is crucial to stress that adopting vegetarianism in conjunction with athletic performance is associated with a 24% reduced prevalence of ischemic heart disease and altered blood pressure when compared to omnivores with identical body mass indices (BMIs) (Teixeira et al, 2006).

Although it is well known that this diet improves athletic performance, greater care should be taken to prevent nutritional deficits.Therefore, this study was relevant since it demonstrated that the nutritionist is the expert who can provide nutritional guidance about food and athletic performance.Therefore, determining the effectiveness of vegetarian diets in relation to athletic performance was the main goal.

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Diets That Are Vegetarian

Adopting a vegetarian lifestyle has several justifications, since it is founded on both emotional and intellectual considerations, including animal rights, health, and environmental advantages, in addition to a straightforward dietary choice. According to data from the Brazilian Vegetarian Society, over half of Brazilians choose to follow a vegetarian diet because they oppose animal abuse and think it is morally wrong to kill another living thing8,1. Other individuals support the diet because they consider the harm that the production of these animals does to the environment, primarily deforestation and water source contamination, among other things. The health advantages of vegetarianism over omnivory, which lowers the risk of non-transmissible chronic illnesses and overall mortality, are another popular justification for adopting this lifestyle (Ferreira, Burini, Maia, 2006; Abonizio, 2016). Although a plant-based diet is the foundation of the vegetarian diet, there are several subgroups of vegetarians, including vegans. Foods derived from animals or even their derivatives are not consumed by this group. They oppose animal exploitation in all its forms for ethical reasons (Lenz, Slywitch, Couceiro, 2008; Marangon, Obeid, 2015).

Lactovegetarians, who abstain from all forms of meat and eggs but drink milk and its derivatives, are another category that falls within the vegetarian diet (Costa, Vaisberg, 2002; Gomes, Silva, Carmo, 2006).Ovolactovegetarians are another group that falls under this diet category. They differ from vegans and lactovegetarians in that they eat eggs, milk, and its byproducts, but they also avoid all forms of meat (Moralejo, 2014; Gomes, Silva, Carmo, 2006).Although there are small differences between the classifications, both present an excellent physical and mental quality of life standard, a situation that has been proven by scientific research (Hall, 2014).

Athletes' nutritional requirements When it comes to athletes, meeting their dietary demands is crucial. Low calorie intake can lead to bone loss, muscle loss, disruptions in athletes' menstrual cycles, and an increased risk of weariness and injury, according to the American College of Sports Medicine (ACSM). Strength athletes typically require at least 50 kcal/kg/day, which translates to 3,500 kcal/day for a 70 kg individual, whereas endurance athletes should consume between 3,000 and 5,000 kcal/day (Teixeira et al, 2006; Biesek, Alves, Guerra, 2015). Adapting what is advised for each audience based on their unique characteristics is a well-thought-out technique. However, the professional nutritionist's job is to properly plan a vegetarian diet for the athlete's nutritional needs because, no matter what diet the athlete chooses, his or her performance won't be impacted if they meet their energy needs (Ferreira, Burini, Maia, 2006; Panza et al, 2007).

The Carbohydrate

The body uses carbohydrates for a number of purposes, including energy and structural support. There are still professionals today who cut off carbs from their meals without even realizing how much this might impair the body's ability to operate normally (Moralejo, 2014; Fontan, Amadio, 2015). Vegetarian diets typically contain a lot of carbohydrates, which increases the amount of substrate available for the creation of glycogen. To promote the synthesis of muscle and liver glycogen, athletes require a diet rich in carbohydrates. The recommended daily intake of carbohydrates should be between 60 and 70 percent, or 6 to 10 grams per kilogram of body weight. However, the athletes' uniqueness, energy expenditure, gender, modality, and ambient factors will also influence this need (Ferreira et al, 2006; Fontan, Amadio, 2015). Although there is a vast array of carbohydrates that may be ingested before to exercise, one of the most important findings about this selection is that it is directly related to the glycemic index (GI). It is simply the Rodrigues & Santos glycemic index. A vegetarian diet and the connection between sport 98 speed and the release of glucose into the bloodstream as a result of eating certain foods. The rate is categorized as low if it is less than 55, medium if it is between 56 and 69, and high if it is greater than 70. Several studies have already demonstrated the benefits of consuming carbohydrates with a low glycemic index before to exercise (Fontan, Amadio, 2015). Sports supplements that include carbohydrates, such maltodextrin, glucose, fructose, and sucrose, as well as certain sports beverages, gels, and energy drinks, are

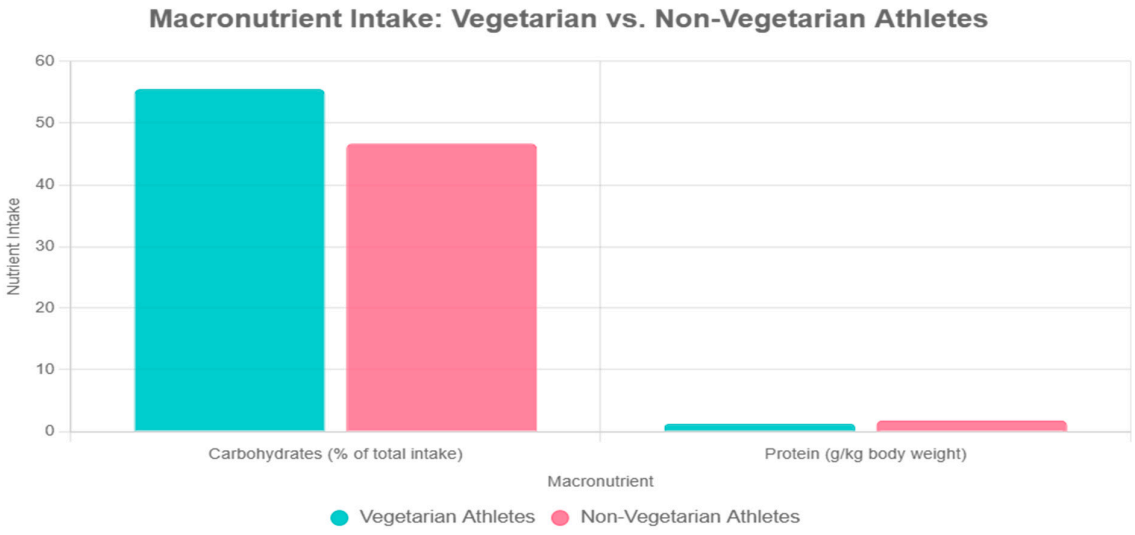
 doi:10.20944/preprints202507.1741.v1

ultimately chosen by the great majority of athletes. It is still possible to add sufficient primary food sources despite the high efficiency shown by the results (Fontan, Amadio, 2015).

The Proteins

Twenty distinct types of tiny molecules called amino acids make up protein. These molecules are joined in chains or chains with varied combinations or sequences. Twelve of the twenty amino acids that humans may manufacture are referred to as non-essential since they are not obtained via diet. The remaining eight, which come from the food we eat, are the most important (Moralejo, 2014; Meirelles, Veiga, Soares, 2001). In addition to being necessary for growth and hormone production, proteins are involved in the transport of oxygen (hemoglobin), defence against infections (antibodies), chemical reaction catalysis (enzymes), membrane receptors, and muscle contraction (actin and myosin) (Hernandez et al, 2009; Gomes, Silva, Carmo, 2006). Protein is therefore seen as necessary for people who engage in physical activity. Because they need a greater protein intake, athletes with protein demands have recently drawn particular attention from researchers. Protein is regarded as an auxiliary energy source for the exercise performed, so 1.6 to 1.7 grams per kilogram of body weight per day is recommended if the goal is to increase lean body mass; for endurance exercise, this amount is recommended at 1.2 to 1.6 grams per kilogram of body weight per day (Hernandez, 2009). When compared to omnivore protein consumption, vegetarians often consume smaller amounts of protein. Studies show that despite vegetables' lower supply of essential amino acids, a vegetarian diet is sufficient because complementary vegetables such legumes, seeds, and greens.They are able to make up for the shortfall (Ferreira, Burini, Maia, 2006). As a result, vegetarian athletes can attain a sufficient protein intake with a diet meticulously designed by a qualified nutritionist (Ferreira, Burini, Maia, 2006).

Vegetarian vs. Non-Vegetarian Diets for Athletes



This chart visualizes the significant difference in dietary intake, with vegetarian athletes consuming more carbohydrates (55.5% vs. 46.7%) and less protein (1.25 g/kg vs. 1.8 g/kg) than non-vegetarian athletes, as reported in studies. The higher carbohydrate intake may support endurance, while lower protein could require strategic planning to meet muscle repair needs.

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Lipids

The components of the cell membrane and the carrier of the fat-soluble vitamins A, D, and E are lipids, which also give off energy. Approximately 25–30% of energy comes from fats. 10% is the recommended amount of saturated, polyunsaturated, and monounsaturated fatty acids. Since vegetarians avoid eating animal products, their fat levels are often lower (Moralejo, 2014; Meirelles, Veiga, Soares, 2001). Fatty acids are vital for oxidative fibers of slow contraction during physical exercise because the energy derived from oxidative processes is crucial during moderate and prolonged physical activity. Accordingly, lipids give muscles the energy they need to engage in physical exercise (Peruffo, 2015; Slywitch, 2012).

Immunological Functions

The majority of people believe that vegetarian diets are linked to nutritional deficits and that they may, in certain cases, impede the healthy operation of every bodily system. Nonetheless, research links the advantages of this diet to the body, including the immune system, one of the primary systems, operating properly, as eliminating meat from the diet has no negative effects on this function (Ferreira, Burini, Maia, 2006). The immune system can react to physical activity in a number of ways; frequent, moderate physical activity has a very good effect. However, following training, immunosuppressive effects may result from severe physical activity carried out under stressful circumstances (COSTA ROSA, 2002).

Long-term overtraining can lead to some changes that eventually show up, like a persistent decline in performance, along with one or more physical symptoms, such as elevated resting heart rate, weight loss, decreased libido, and changes in sleep patterns (Ribeiro, Alvarenga, Coelho, 2008).

Creatines in Muscle

There are two categories of amino acids: essential and non-essential. Since our bodies are capable of producing it, creatine is an amino acid that belongs to the second category, the non-essential ones. However, despite this bioavailability in our own organism, many foods of animal origin have an abundant source of this compound, such as meat and fish (Ferreira, Burini, Maia, 2006). Creatine is a chemical compound formed by hydrogen, nitrogen and carbon. This compound is synthesized in the kidneys, pancreas, and liver, and produced endogenously, It provides around 1g every day. The human body's muscles contain the majority of creatine, which is obtained by diet at an average of 1g each day. It is essential for supplying energy, which is first found at rest in the form of phosphocreatine. Phosphocreatine is broken down during physical exercise to produce creatine and ATP, which are necessary for muscular contraction and the athlete's healthy growth during athletic performance (Moralejo, 2014; Slywitch, 2012). Santos & Rodrigues. The connection between the vegetarian diet and sport 99 Creatine levels in vegetarians' bodies are typically low. This is mostly because vegetarians don't eat foods that contain this kind of amino acid. However, compared to omnivore athletes, it has been demonstrated that vegetarian athletes who supplement with this amino acid have higher amounts of creatine in their muscles and lean mass (Moralejo, 2014; Lenz, Slywitch, Couceiro, 2008).

Changes in Hormones

Athletes may experience hormonal changes during exercise as a result of their quest for variety in training, including volume, intensity, and recuperation. The hormone concentrations may be less well known in connection to nutrition. Compared to non-vegetarian athletes, vegetarian athletes had lower testosterone levels (Ferreira, Burini, Maia, 2006; Zilinski, Gouvinhas, 2015). Plant compounds classified as phytosterols and phytoestrogens are known as phytoestrogens. They are a subset of phyto-complexes. Soy's phytoestrogens help to reduce levels of androstenedione and testosterone. IGF-1, a growth hormone produced by the liver, is another hormone that is associated with vegetarian

 doi:10.20944/preprints202507.1741.v1

athletes and women who have low levels of it in their bodies. Low lipid intake may be the cause of all of these (Zilinski, Gouvinhas, 2015; Nelson, 2009). Because these hormones are anabolic, athletes' low hormone concentrations may have detrimental consequences on their ability to build muscle and strength during training. When compared to milk protein, vegetarian protein supplements, including soy protein, can significantly raise IGF-1 levels (Zilinski, Gouvinhas, 2015; Moralejo, 2014).

Iron

In 1960, iron became the first mineral to be recognized as a necessary nutrient for the body's healthy operation. Numerous investigations were conducted after that to find out more about this mineral's advantages. This compound is very important for several essential functions of the body and the lack of it can cause several problems, being considered a major public health problem in the world. Many studies prove the present deficiency of this mineral, not only in athletes, regardless of their diet (Biesek, Alves, Guerra, 2015; Panza Et Al, 2007; Nishimori, 2008). It contributes to DNA synthesis, mitochondrial respiration, oxygen transport, oxidative energy generation, and the deactivation of dangerous O2 radicals. Although iron can also be found in plant sources, animal diets provide the majority of its bioavailability. Heme, which is more prevalent in meat, and non-heme, which is more prevalent in plant-based foods, are the two forms of iron (Moralejo, 2014; Nishimori, 2008). The phytates found in vegetables and legumes, the polyphenols in wines, teas, coffee, soybeans, and calcium are examples of plant items that include iron inhibitors. All of these items ultimately impair the body's capacity to absorb iron. Conversely, certain iron-enhancing items, such vitamin C and carotenes, aid in raising the body's non-heme iron levels (Miranda et al, 2013). The question of whether vegetarianism or non-vegetarianism is better for athletes is complicated since each dietary pattern has unique benefits and drawbacks. When carefully thought out, vegetarian diets can satisfy athletes' nutritional demands while also potentially providing certain health advantages, such a decreased chance of developing chronic illnesses. They could, however, also present problems with regard to the availability of micronutrients and the quality of protein, both of which are essential for athletic performance. On the other hand, non-vegetarian diets may not offer all of the health advantages of plant-based diets, but they usually offer higher-quality protein and other nutrients more easily. These elements are thoroughly examined in the sections that follow.

When carefully designed to incorporate a range of plant-based meals, vegetarian diets can offer enough energy and macronutrients to sustain athletic performance. According to Dmowska et al. (2024), these diets tend to be richer in carbs, which is advantageous for endurance sports (Venderley & Campbell, 2006). However, because of their less desirable amino acid compositions and bioavailability, vegetarian diets may result in lower-quality protein. Muscle mass and strength may be impacted, thus careful planning is necessary to guarantee sufficient protein intake. Vegetarian athletes may need an extra 10–22 grams of protein per day (Ciuris et al., 2019). Higher protein quality and bioavailability are often seen in non-vegetarian diets, which can better promote strength and muscular building. Compared to their vegetarian colleagues, omnivorous athletes typically have more lean body mass.

Athletic Performance Comparison (Endurance and Strength)

This bar chart compares performance metrics (endurance and strength) between vegetarian and non-vegetarian athletes, showing no significant differences in key performance indicators like VO2 max and muscle strength.

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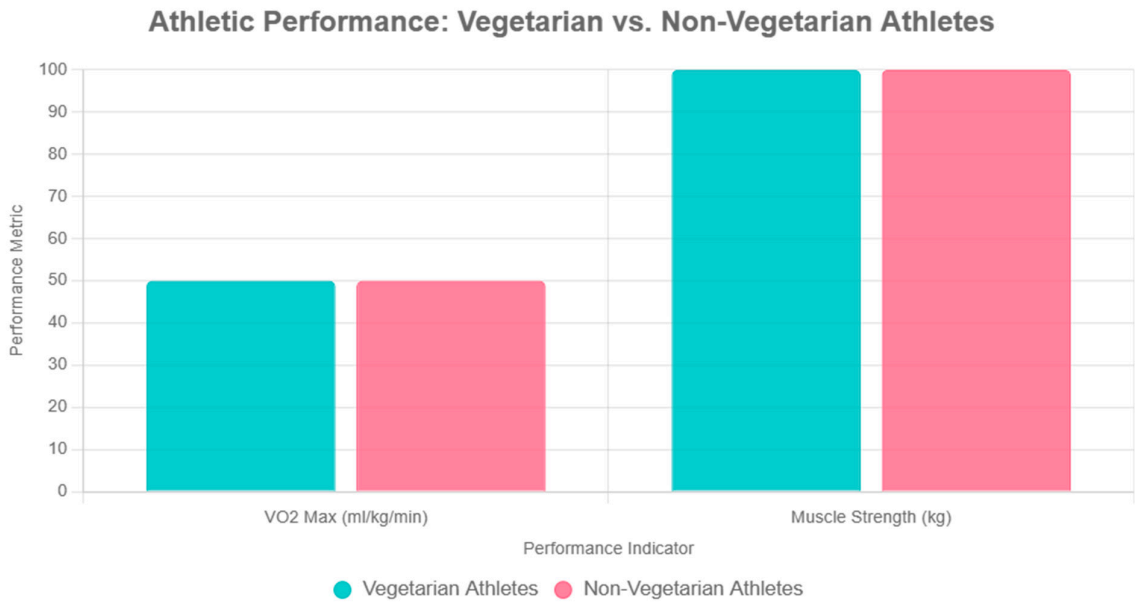

This chart illustrates that vegetarian and non-vegetarian athletes show comparable performance in endurance (VO2 max) and strength (measured via resistance training outcomes). The values are normalized (e.g., 50 ml/kg/min for VO2 max and 100 kg for strength) to reflect the lack of significant differences found in studies. This supports the conclusion that well-planned vegetarian diets can sustain athletic performance at levels similar to omnivorous diets.

Micronutrient Considerations

Vegetarian athletes may face challenges in obtaining sufficient iron, zinc, vitamin B12, vitamin D, and calcium, as these nutrients are more bioavailable in animal products. Deficiencies in these nutrients can adversely affect performance and health (Venderley & Campbell, 2006) (Zhou et al., 2013) (Rosdiana et al., 2022). Despite these challenges, vegetarians often have higher antioxidant status, which may help reduce exercise-induced oxidative stress. This could potentially offer some performance benefits, although more research is needed in this area (Venderley & Campbell, 2006). Non-vegetarian diets typically provide these micronutrients more readily, reducing the risk of deficiencies that could impair performance (Borrione et al., 2009). Vegetarian diets are typically higher in carbohydrates and lower in protein compared to omnivorous diets. This macronutrient profile can be beneficial for endurance sports, which rely heavily on carbohydrate stores for energy (Hernández-Lougedo et al., 2023) (Ahmed et al., 2022). There are concerns about the bioavailability of certain nutrients in vegetarian diets, such as iron, zinc, vitamin B12, and omega-3 fatty acids, which are crucial for athletic performance and recovery. These nutrients can be less bioavailable in plant-based sources, necessitating careful dietary planning (Ahmed et al., 2022) (Neto et al., 2022) (Mete et al., 2022).A well-planned vegetarian diet can meet the nutritional needs of athletes, provided that attention is given to potential deficiencies and appropriate supplements or fortified foods are included (Mete et al., 2022) (Rosdiana et al., 2022).Vegetarian diets are typically higher in carbohydrates and lower in protein compared to omnivorous diets. This macronutrient profile can be beneficial for endurance sports, which rely heavily on carbohydrate stores for energy (Hernández-Lougedo et al., 2023) (Ahmed et al., 2022).There are concerns about the bioavailability of certain nutrients in vegetarian diets, such as iron, zinc, vitamin B12, and omega-3 fatty acids, which are crucial for athletic performance and recovery. These nutrients can be less bioavailable in plant-based sources, necessitating careful dietary planning (Ahmed et al., 2022) (Neto et al., 2022) (Mete et al., 2022).A well-planned vegetarian diet can meet the nutritional needs of athletes, provided that attention is given to potential deficiencies and appropriate supplements or fortified foods are

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included (Mete et al., 2022) (Rosdiana et al., 2022).Vegetarian athletes may face challenges in obtaining adequate levels of certain nutrients, such as protein, essential fatty acids, iron, zinc, calcium, iodine, vitamin D, and vitamin B12, which are more readily available in animal products (Rosdiana et al., 2022) (Luna et al., 2024) (Zhou et al., 2013).

Vegetarian athletes can achieve their nutritional demands and prevent deficiencies by using supplements and fortified foods as part of a proper diet plan (Luna et al., 2024) (Zhou et al., 2013).Vegetarian athletes must keep an eye on their nutrient consumption and eat a balanced diet to make sure they obtain enough energy and nutrients for training and recuperation (Rosdiana et al., 2022). (Mete et al., 2022). Reduced risks of ischemic heart disease, hypertension, and type 2 diabetes are among the health advantages linked to vegetarian diets. By encouraging general health and longevity, these health advantages may tangentially enhance sports performance (Craig & Mangels, 2009). However, because of certain dietary inadequacies, vegetarian diets might potentially increase the risk of oligomenorrhea and amenorrhea, especially in female athletes (Borrione et al., 2009).If balanced and diverse, non-vegetarian diets may not necessarily carry these dangers, even though they do not offer the same degree of protection for chronic diseases (Borrione et al., 2009).By improving general health and lowering the chance of injury, vegetarian diets are linked to a lower risk of chronic illnesses, which can tangentially improve athletic performance (Craddock et al., 2016; Borrione et al., 2009). The high antioxidant content in vegetarian diets may aid in recovery and reduce oxidative stress, which is beneficial for athletes undergoing intense training (Ahmed et al., 2022).Athletes transitioning to a vegetarian diet should do so with guidance from a nutritionist or dietitian to ensure that their diet is balanced and meets all nutritional requirements (Mete et al., 2022) (Rosdiana et al., 2022).It is crucial for vegetarian athletes to monitor their intake of critical nutrients and consider supplementation if necessary to prevent deficiencies that could impair performance (Borrione et al., 2009) (Sousa, 2023). By improving general health and lowering the chance of injury, vegetarian diets are linked to a lower risk of chronic illnesses, which can tangentially improve athletic performance (Craddock et al., 2016). Borrione and colleagues (2009).For athletes enduring rigorous exercise, the high antioxidant content of vegetarian meals may promote recovery and lower oxidative stress (Ahmed et al., 2022). Research on the effect of vegetarian diets on sports performance yields conflicting findings. According to some study, vegetarian and non-vegetarian athletes do not significantly vary in performance indicators like VO2 max, muscular power, and sprint tests (Hernández-Lougedo et al., 2023; Rosdiana et al., 2022). Other studies suggest that vegetarian athletes may have better lower limb strength and power, although these findings are not consistent across all research (Souza et al., 2022). While vegetarian diets can be nutritionally adequate and offer certain health benefits, they require careful planning to avoid nutrient deficiencies that could impair athletic performance. Non-vegetarian diets generally provide higher protein quality and certain nutrients more readily, which can be advantageous for muscle mass and strength. Ultimately, the choice between vegetarian and non-vegetarian diets for athletes may depend on individual preferences, dietary planning, and specific performance goals. Further research is needed to fully understand the long-term impacts of these dietary patterns on athletic performance. Several studies have found no significant differences in physical performance metrics, such as VO2 max, muscle power, and sprint tests, between vegetarian and omnivorous athletes. This suggests that a vegetarian diet does not inherently hinder athletic performance (Hernández-Lougedo et al., 2023) (Araújo et al., 2021) (Craddock et al., 2016).

Some research indicates that vegetarian athletes may have a higher VO2 max, which could positively influence endurance performance, although this finding is not universally observed across all studies (Araújo et al., 2021). Numerous studies have shown no discernible differences between vegetarian and omnivore athletes in terms of physical performance measures as VO2 max, muscular power, and sprint tests. This implies that eating a vegetarian diet does not always impair athletic performance (Craddock et al., 2016; Araújo et al., 2021; Hernández-Lougedo et al., 2023).

Some research indicates that vegetarian athletes may have a higher VO2 max, which could positively influence endurance performance, although this finding is not universally observed across

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all studies (Araújo et al., 2021). Carbohydrate and Protein Intake: Vegan diets are typically higher in carbohydrates and lower in protein compared to omnivorous diets. This macronutrient distribution can be beneficial for endurance sports due to the increased availability of carbohydrates, which are crucial for energy during prolonged activities (Ahmed et al., 2022) (Hernández-Lougedo et al., 2023) ("A Comparison of Diet Quality and Cardiovascular and Inflammatory Responses between Aerobically Trained Male Adults Following Either a Long-term Vegan or Omnivorous Dietary Pattern," 2023). However, the lower protein intake may pose challenges for strength and muscle mass maintenance, as observed in some studies where a decrease in skeletal muscle mass was noted during a vegan phase (Isenmann et al., 2024) (Pohl et al., 2021). Vegan diets may lead to deficiencies in essential nutrients such as vitamin B12, iron, calcium, and zinc, which are critical for athletic performance and recovery. These deficiencies can affect hemoglobin levels and muscle function, potentially impacting endurance and strength performance (Maziarz et al., 2020) (Rosdiana et al., 2022).

Research indicates that vegan diets may offer advantages for endurance performance due to enhanced mitochondrial function and carbohydrate availability. However, for strength performance, the lower availability of certain nutrients like creatine and leucine in vegan diets may be disadvantageous (Pohl et al., 2021). Studies have shown mixed results, with some indicating no significant differences in performance metrics between vegan and omnivorous athletes (Hernández-Lougedo et al., 2023) (Durkalec-Michalski, 2022). Transitioning to a vegan diet can lead to changes in body composition, such as reduced body weight and muscle mass, which may affect performance. However, these changes do not necessarily translate to decreased performance, as some studies report no significant impact on physical performance measures like VO2 max and muscle power (Isenmann et al., 2024) ("A Comparison of Diet Quality and Cardiovascular and Inflammatory Responses between Aerobically Trained Male Adults Following Either a Long-term Vegan or Omnivorous Dietary Pattern," 2023).

As more athletes switch to plant-based diets for ethical, environmental, or health reasons, there is increasing interest in the connection between vegetarianism and athletic performance. According to the available data, a well-planned vegetarian diet may have certain health advantages and has no detrimental effects on athletic performance. To guarantee optimum performance, certain food intake factors must be taken into account. The main conclusions of contemporary research on this subject will be examined in this response. While the current evidence suggests that a vegetarian diet does not negatively impact sports performance, it is important to note that the research is still limited, and more studies are needed to fully understand the long-term effects of vegetarianism on athletic performance. Additionally, individual responses to dietary changes can vary, and what works for one athlete may not work for another. Customized food regimens are recommended to optimize performance outcomes. The relationship between vegetarianism and athletic performance is gaining attention as more athletes adopt plant-based diets for moral, environmental, or health-related reasons. Based on the information that is currently available, a well-planned vegetarian diet has no negative impact on athletic performance and may have some health benefits. Certain parameters related to food consumption must be considered in order to ensure optimal performance. In this answer, the key findings of recent studies on this topic will be reviewed.

To make sure their diet is balanced and satisfies all nutritional needs, athletes making the switch to a vegetarian diet should get advice from a dietitian or nutritionist (Mete et al., 2022). (Rosdiana et al., 2022). To avoid deficits that might affect performance, vegetarian athletes must keep an eye on their consumption of essential nutrients and, if needed, think about taking supplements (Borrione et al., 2009) (Sousa, 2023). Even if there is now little evidence that a vegetarian diet has a detrimental effect on athletic performance, it is crucial to remember that additional study is required to completely comprehend the long-term consequences of vegetarianism on athletic performance.

Furthermore, different people react differently to nutritional modifications, so what suits one athlete might not suit another. In order to maximize performance outcomes, customized dietary regimens are advised. For athletes to successfully adopt a vegan diet, careful preparation is necessary

 doi:10.20944/preprints202507.1741.v1

to guarantee sufficient consumption of all vital components. This entails keeping a balanced macronutrient profile to promote training and recovery and implementing fortified meals or supplements to address any possible deficiencies (B & Julieta, 2013) (Rosdiana et al., 2022). As athletes become used to new eating habits, switching from an omnivore to a vegan diet can be difficult, especially in the beginning. To maintain nutritional adequacy and reduce performance disturbances, this time may call for extra assistance and instruction (Isenmann et al., 2024). While the vegan diet can be compatible with sports performance, it is essential to recognize the potential challenges and plan accordingly. Athletes considering a vegan diet should work with nutritionists to ensure their dietary needs are met, particularly concerning protein and micronutrient intake. Further research is needed to explore the long-term effects of vegan diets on athletic performance and to develop strategies for optimizing nutrient intake in vegan athletes.

Vegetarian diet (VD) and Sports Performance

The effect of a vegan diet (VD) on sports performance is a multifaceted topic that has garnered significant attention in recent years. While some studies suggest potential benefits of a vegan diet for athletes, others highlight challenges related to nutrient adequacy and performance outcomes. The current body of research indicates that while a vegan diet can support athletic performance, it requires careful planning to ensure nutritional adequacy and optimize performance outcomes. Below, key aspects of the impact of a vegan diet on sports performance are discussed. There is increasing interest in the connection between vegetarian diets and athletic performance since studies show that a well-planned vegetarian diet can improve athletic performance without having a major negative impact. Vegetarian diets can make it difficult to achieve some dietary requirements, but when followed correctly, they don't always affect athletic performance. The nutritional aspects, performance consequences, and possible advantages of vegetarian diets for athletes will all be covered in this summary.

Studies have shown no significant differences in physical performance metrics, such as VO2 max, muscle power, and sprint tests, between vegetarian and omnivorous athletes (Hernández-Lougedo et al., 2023) (Araújo et al., 2021). Vegetarian diets, when well-planned, can support similar performance levels to those observed in athletes following omnivorous diets (Luna et al., 2024) (Zhou et al., 2013). Some research suggests that vegetarian diets may offer benefits for endurance athletes, potentially enhancing cardiovascular health and endurance performance (Dmowska et al., 2024). Vegetarian diets can improve general health and lifespan by lowering the risk of non-communicable illnesses such cardiovascular disease, type 2 diabetes, and several types of cancer (Luna et al., 2024). The higher carbohydrate intake typical of vegetarian diets may be advantageous for endurance athletes, as carbohydrates are a primary energy source during prolonged exercise (Hernández-Lougedo et al., 2023) (Dmowska et al., 2024). Vegetarian diets may also promote better body weight management and improved blood lipid profiles, which are beneficial for athletic performance (Dmowska et al., 2024). While vegetarian diets can support athletic performance, they require careful planning to ensure nutritional adequacy. Athletes considering a vegetarian diet should consult with nutrition professionals to tailor their dietary intake to their specific needs and training demands. Despite the potential challenges, vegetarian diets do not inherently impair athletic performance and may offer certain health benefits. However, more research is needed to fully understand the long-term effects of vegetarian diets on athletic performance across different sports and levels of competition.

Non-Vegetarian diet and Athletic Performance

A non-vegetarian diet can play a significant role in an athlete's performance by providing essential nutrients that are sometimes less bioavailable in vegetarian diets. While vegetarian diets can be well-planned to meet the nutritional needs of athletes, non-vegetarian diets naturally include certain nutrients that are crucial for athletic performance, such as high-quality protein, creatine, and

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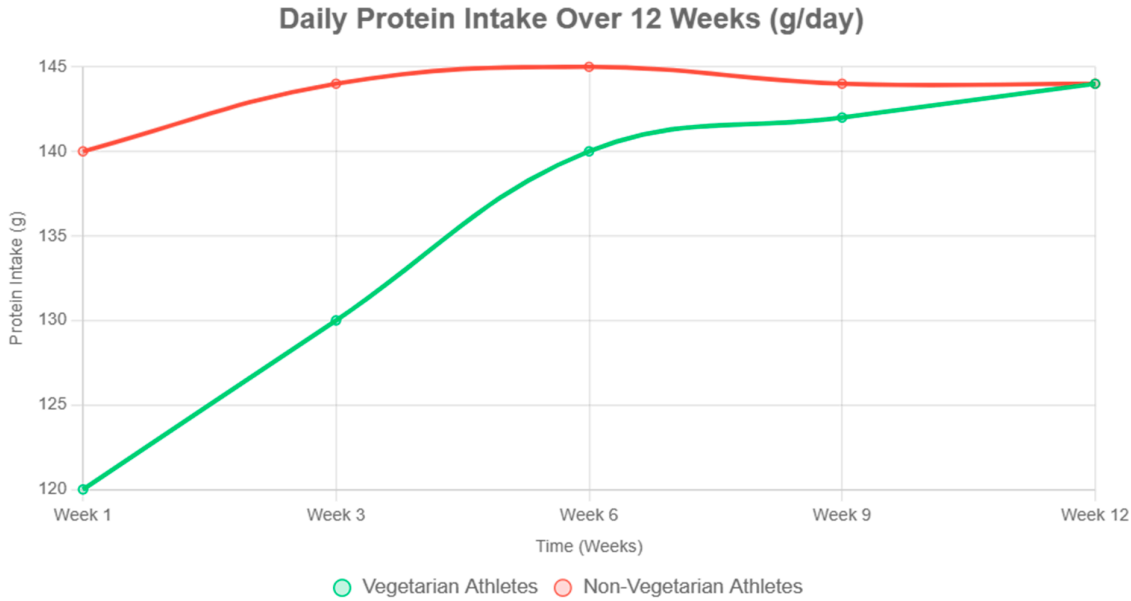
certain vitamins and minerals. These nutrients are vital for muscle repair, energy production, and overall health, which are critical for athletes.

Protein and Muscle Repair

Non-vegetarian diets provide complete proteins, which contain all essential amino acids necessary for muscle repair and growth. Animal proteins are considered high-quality due to their amino acid profile and digestibility (Venderley & Campbell, 2006) (Rietjens, 2022). Creatine, found in meat, is crucial for energy production during high-intensity exercise. It helps replenish ATP, the energy currency of the cell, which is vital for short bursts of activity (Venderley & Campbell, 2006). Non-vegetarian diets are rich in bioavailable iron, which is essential for oxygen transport and energy metabolism. The body absorbs heme iron—iron derived from animals—more easily than non-heme iron derived from plants (Venderley & Campbell, 2006). Rietjens (2022). Animal products naturally contain vitamin B12, which is essential for the production of red blood cells and brain function. Fatigue and poor performance can result from B12 deficiencies (Venderley & Campbell, 2006). Rosdiana and associates, 2022 Fish is a great source of essential fatty acids, especially omega-3s like EPA and DHA, which are crucial for lowering inflammation and promoting cardiovascular health. These fatty acids are less prevalent in plant-based diets (Rogerson, 2017). Animal fats also provide a dense source of energy, which can be beneficial for athletes with high caloric needs (Rietjens, 2022).

The combination of high-quality protein, creatine, and essential fatty acids in a non-vegetarian diet can enhance recovery times and improve overall performance. These nutrients support muscle repair, reduce inflammation, and provide sustained energy (Rietjens, 2022) (Rogerson, 2017). While non-vegetarian diets offer certain advantages, it is important to note that vegetarian and vegan diets can also support athletic performance if carefully planned. Vegetarian athletes can meet their nutritional needs through strategic food choices and supplementation, ensuring adequate intake of protein, iron, vitamin B12, and omega-3 fatty acids. Athletes may succeed on plant-based diets with the right support, according to research, and vegetarian diets do not necessarily affect athletic performance (Venderley & Campbell, 2006; Rosdiana et al., 2022; Araújo et al., 2021). This chart compares daily protein intake for vegetarian and non-vegetarian athletes over 12 weeks, assuming both aim for 1.8 g/kg body weight (e.g., 144 g/day for an 80 kg athlete). Vegetarians may start slightly lower but optimize intake with supplements or meal planning.



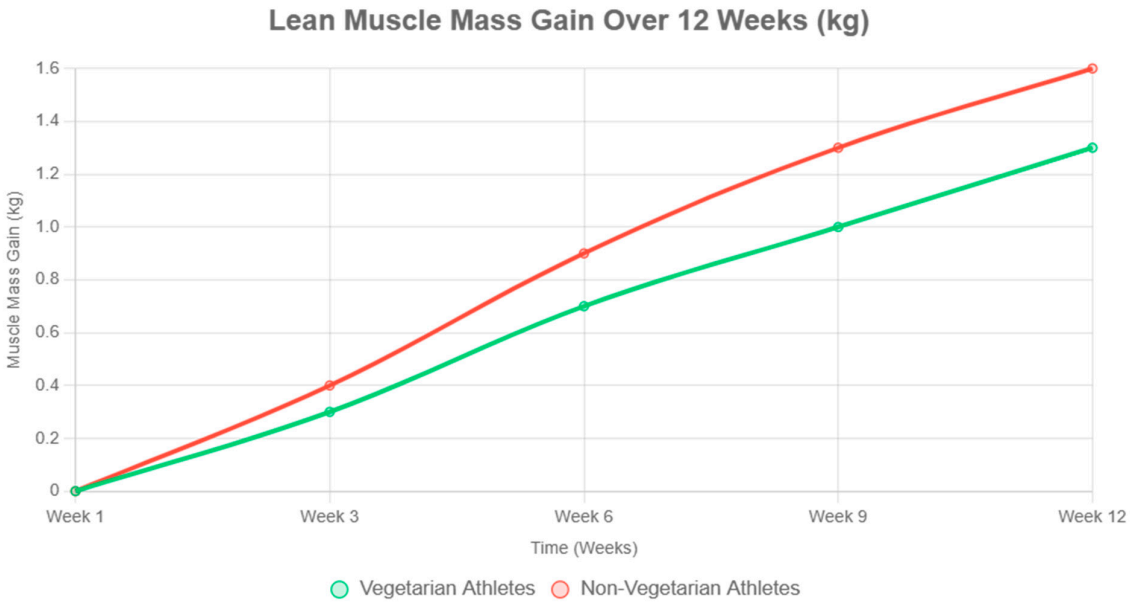
The chart shows vegetarian athletes starting with slightly lower protein intake (120 g/day) but reaching the target (144 g/day) by week 12 through dietary adjustments. Non-vegetarian athletes maintain a steady intake closer to the target from the start due to easier access to high-protein animal

 doi:10.20944/preprints202507.1741.v1

foods. The debate over plant-based versus meat-based nutrition for optimal athletic performance is multifaceted, involving considerations of health benefits, performance outcomes, and dietary adequacy. Plant-based diets are increasingly popular among athletes due to their potential health benefits, including improved cardiovascular health and reduced oxidative stress, which can enhance recovery and performance. However, concerns about protein adequacy and nutrient absorption persist. Conversely, meat-based diets are traditionally favored for their high-quality protein content, which is crucial for muscle mass and strength. This answer explores the benefits and challenges of both dietary approaches for athletes.

Benefits of Plant-Based Nutrition

Plant-based diets are associated with a decreased risk of cardiovascular diseases, better weight management, and improved blood glucose regulation due to their high content of complex carbohydrates, antioxidants, and dietary fiber (Sarmento et al., 2024) (Ayaz et al., 2024). These diets can improve aerobic performance by enhancing blood flow and reducing oxidative stress, which is beneficial for endurance athletes (Damasceno et al., 2023) (Ayaz et al., 2024). Plant-based diets can boost muscle growth and performance by providing athletes with the protein and micronutrients they require with proper preparation (Goldman et al., 2024) (Larson-Meyer & Ruscigno, n.d.). Due to lower quantities of certain amino acids and antinutrients that prevent nutrient absorption, plant-based proteins may not be as efficient as animal proteins at increasing muscle development and strength (Zhao et al., 2024) (Presti et al., 2024). Since animal products provide easier access to minerals like vitamin B12, iron, and omega-3 fatty acids, athletes following plant-based diets must be on the lookout for any deficits in these areas (Rietjens, 2022). (Larson-Meyer & Ruscigno, n.d.). Although plant-based diets provide advantages for performance and health, they must be carefully planned to guarantee adequate intake of certain elements, especially micronutrients and protein. Meat-based diets provide high-quality protein and essential nutrients but may pose health risks if consumed excessively. Athletes can achieve optimal performance with either diet by tailoring their nutritional strategies to meet their specific needs and goals. This chart tracks lean muscle mass gains over 12 weeks, assuming both groups follow resistance training and consume adequate calories. Non-vegetarian athletes may show slightly faster gains due to higher leucine availability.



Optimal nutritional strategies for athletes are crucial for enhancing performance and supporting recovery. These strategies involve a comprehensive approach that includes macronutrient balance, hydration, supplementation, and personalized nutrition plans tailored to the specific needs of the

 doi:10.20944/preprints202507.1741.v1

athlete and their sport. Combining these factors can lower the chance of injury, speed up healing, and greatly enhance athletic performance. The essential elements of the best dietary plans for athletes are described in the sections that follow.

Drinking enough water before, during, and after exercise is essential for preserving blood glucose levels, enhancing performance, and speeding up recovery. Electrolytes and carbohydrates found in sports drinks can assist sustain energy levels and hydration (Rietjens, 2022) (C & P, 2024). Optimizing performance and recovery requires customized nutrition regimens that take into account the needs of each athlete, the demands of their sport, and their personal objectives. To make sure they satisfy each athlete's specific needs, these programs have to be guided by genetic and metabolomic analysis (Nutritional Strategies for Peak Performance: Guidelines for Athletes' Optimal Fueling and Recovery, n.d.) (Hwang & Yang, 2024).

Nutrient Timing

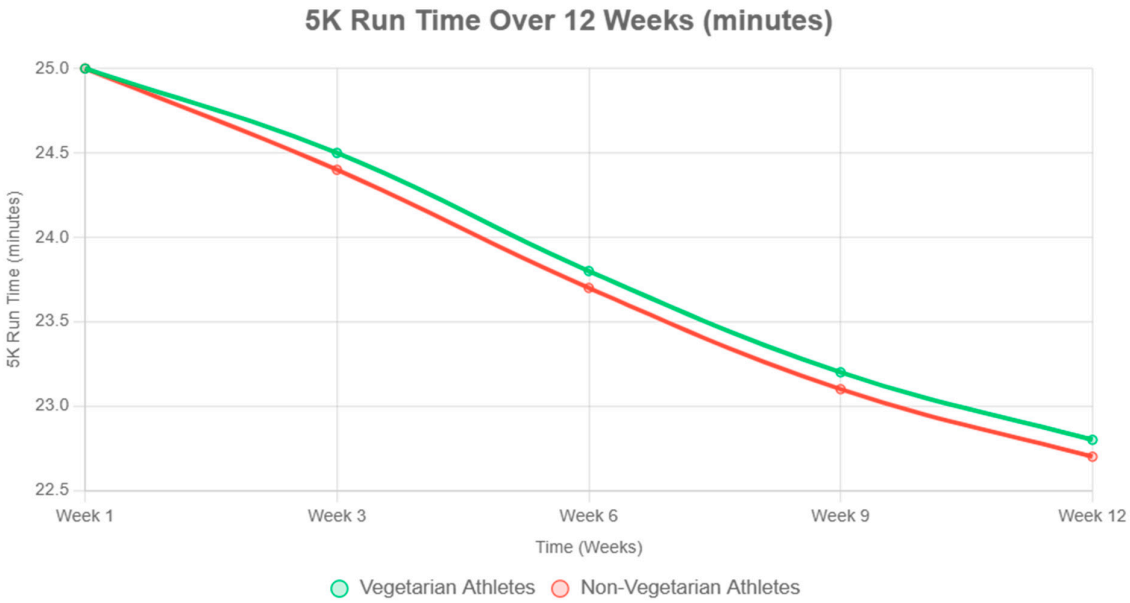
The timing of nutrient intake is essential for maximizing performance and recovery. Taking food helps to maintain, energy levels and supports recovery processes (Rietjens, 2022) (C & P, 2024).While the outlined strategies provide a robust framework helps in improving performance, it is important to consider the individual variability among athletes. Intensity kind issues, and metabolic needs can influence the effectiveness of nutritional strategies. Additionally, the use of supplements and ergogenic aids should be approached with caution, ensuring they are safe, legal, and effective. Personalized nutrition plans that adapt to the evolving needs of athletes can further optimize outcomes and support long-term athletic success. The debate over whether a vegetarian (VEG) or non-vegetarian (non-VEG) diet is preferable for athletes to enhance performance and support recovery is multifaceted, with both dietary approaches offering distinct advantages and challenges. A well-planned vegetarian diet can meet the nutritional needs of athletes, providing sufficient energy and macronutrients to support performance and health. However, Conversely, a non-vegetarian diet naturally includes these nutrients but may not offer the same antioxidant benefits as a vegetarian diet. The choice between these diets depends on individual preferences, nutritional planning, and specific athletic goals. Both vegetarian and non-vegetarian diets can provide the necessary macronutrient distribution for athletes, with carbohydrates, fats, and proteins being adequately supplied in both dietary patterns. Vegetarian diets, however, often require more careful planning to ensure adequate protein intake from plant-based sources (Venderley & Campbell, 2006) (Rosdiana et al., 2022). Because these nutrients are more accessible in animal products, vegetarian athletes may have trouble getting enough iron, zinc, vitamin B12, vitamin D, and calcium. Supplements and fortified meals can lessen these inadequacies (Venderley & Campbell, 2006). Borrione et al. (2009) and Zhou et al. (2013). Antioxidants including vitamin C, vitamin E, and beta-carotene are often more abundant in vegetarian diets, which may lessen oxidative stress brought on by exercise and aid in recovery (Venderley & Campbell, 2006).Cardiovascular Health and Endurance: According to some research, vegetarian diets may benefit endurance athletes since they have favourable impacts on cardiovascular health, such as better cholesterol and blood pressure profiles (Dmowska et al., 2024).Performance Comparisons: Studies show that when diets are properly managed, there is no discernible difference in the performance of vegetarian and non-vegetarian athletes.

Risk of Deficiencies: Vegetarian athletes, particularly vegans, are at a higher risk of nutrient deficiencies, which can impact performance and recovery. Regular dietary assessments and nutrient monitoring are recommended to prevent deficiencies (Zhou et al., 2013) .

Creatine and Muscle Mass: Non-vegetarian diets naturally provide creatine, which is beneficial for muscle mass and performance. Vegetarians may need to consider creatine supplementation to achieve similar benefits (Venderley & Campbell, 2006). While both vegetarian and non-vegetarian diets can support athletic performance, the choice largely depends on individual preferences and the ability to plan a balanced diet. Vegetarian diets may offer certain health benefits, particularly for endurance athletes, but require careful attention to nutrient intake to avoid deficiencies. Non-vegetarian diets provide a more straightforward approach to meeting nutritional needs but may lack

 doi:10.20944/preprints202507.1741.v1

the antioxidant benefits of a plant-based diet. Ultimately, the effectiveness of either diet in enhancing performance and supporting recovery hinges on the athlete's commitment to maintaining a balanced and nutrient-rich dietary regimen. This chart compares improvements in 5K run times (minutes) over 12 weeks, assuming both groups train similarly and vegetarian athletes supplement iron and B12 to prevent deficiencies.



Relevant researches related to present manuscripts indicates that Kaur, M. S. G., & Singh, S. P. (2019). Effect of selected massage and yogic exercise on the recovery pattern of blood lactate after an endurance workout. International Journal of Physiology, Nutrition and Physical Education, 4(1), 3. Relevance to Manuscript: The manuscript discusses the importance of recovery in athletes, particularly in the context of vegetarian diets, which may influence recovery due to their high antioxidant content (Venderley & Campbell, 2006; Ahmed et al., 2022). Researches focused on massage and yogic exercises on blood lactate recovery post-endurance workout, which is directly relevant to the manuscript's focus on recovery strategies for athletes. While the manuscript does not specifically address massage or yoga, the recovery of blood lactate is a critical factor in endurance performance, which is emphasized in the manuscript for vegetarian athletes due to their higher carbohydrate intake (Hernández-Lougedo et al., 2023).

The study found that selected massage and yogic exercises significantly improved the recovery pattern of blood lactate levels post-endurance exercise, suggesting enhanced recovery mechanisms. This aligns with the manuscript's discussion of how vegetarian diets, rich in carbohydrates, support endurance performance by facilitating glycogen synthesis, which could complement recovery strategies like those studied here (Ferreira et al., 2006; Dmowska et al., 2024). The manuscript notes the potential for vegetarian diets to reduce exercise-induced oxidative stress (Venderley & Campbell, 2006), which could synergize with recovery techniques like massage and yoga to optimize post-exercise recovery. This paper provides evidence that recovery strategies, such as massage and yoga, can enhance lactate clearance, which is relevant for vegetarian athletes who rely on high carbohydrate intake for endurance performance. Nutritionists planning vegetarian diets could incorporate such recovery techniques to further support athletic performance, as suggested in the manuscript's emphasis on tailored nutritional strategies (Rosdiana et al., 2022).

Singh, S., Kumar, S., Kaur, N., Choudhary, S., Sekhawat, D. S., Singh, B., & Kaur, J. (2023). Fluid intake and fluctuation in total body water (TBW), intracellular water (ICW), extracellular water (ECW), skeletal muscle mass (SMM), and percentage body fat (PBF) of track athletes. Community Practitioner, 21(05), 922-934. Relevance to Manuscript: The manuscript highlights the importance of hydration for athletes, stating that proper hydration is critical for maintaining blood glucose

 doi:10.20944/preprints202507.1741.v1

concentration, maximizing performance, and improving recovery time (Rietjens, 2022). This study examines the effects of fluid intake on body water compartments and body composition in track athletes, which directly relates to the manuscript's discussion of nutritional strategies, including hydration, for optimizing athletic performance. The study explores how fluid intake influences total body water, intracellular and extracellular water, skeletal muscle mass, and body fat percentage in track athletes. It provides insights into how hydration affects body composition, which is relevant to the manuscript's discussion of vegetarian athletes' challenges in maintaining muscle mass due to lower protein and creatine intake (Ciuris et al., 2019; Venderley & Campbell, 2006). The manuscript notes that vegetarian diets may lead to changes in body composition, such as reduced muscle mass (Isenmann et al., 2024), making hydration strategies critical for maintaining performance. This paper's focus on hydration and its impact on body composition complements the manuscript's emphasis on the need for careful dietary planning to support vegetarian athletes' performance. Proper hydration, as studied here, could mitigate some of the challenges associated with lower protein and creatine availability in vegetarian diets, ensuring adequate recovery and performance (Rosdiana et al., 2022).

Kumar, R., & Singh, S. (2024). A Comparative Investigation of Physical and Physiological Components of Team Game Athletes from Northeast and South India. Indian Journal of YOGA Exercise & Sport Science and Physical Education, 55-60. Relevance to Manuscript: The manuscript compares vegetarian and non-vegetarian athletes' performance metrics, such as VO2 max and muscle strength, finding no significant differences when diets are well-planned (Hernández-Lougedo et al., 2023). This study compares physical and physiological components across athletes, which could provide insights into how dietary patterns (including vegetarianism) influence performance metrics like endurance and strength, as discussed in the manuscript. Matched Content: The study examines physiological components such as aerobic capacity (VO2 max) and strength among team game athletes, which aligns with the manuscript's comparison of endurance and strength performance between vegetarian and non-vegetarian athletes. It provides data on regional differences in physiological performance, which could be extended to dietary influences, given the manuscript's note that vegetarian diets are common in certain populations (e.g., in Brazil, 50% adopt vegetarianism for ethical reasons, per the Brazilian Vegetarian Society). This paper's focus on physiological performance metrics like VO2 max directly relates to the manuscript's findings that vegetarian and non-vegetarian athletes show comparable endurance performance (Araújo et al., 2021). It supports the manuscript's assertion that dietary patterns, when managed properly, do not inherently impair athletic performance.

Singh, S. P. (2015). An Analysis among Physiological and Physical Fitness of Middle Distance and Long-Distance Runners. International Journal of Advanced Computer Research, 4(4), 6. Relevance to Manuscript: The manuscript emphasizes that vegetarian diets are particularly beneficial for endurance athletes due to their high carbohydrate content, which supports glycogen synthesis (Dmowska et al., 2024). This study analyzes physiological and physical fitness parameters in middle- and long-distance runners, which are directly relevant to the manuscript's discussion of endurance performance in vegetarian athletes. Matched Content: The study compares physiological parameters (e.g., aerobic capacity, cardiovascular efficiency) and physical fitness in middle- and long-distance runners, which aligns with the manuscript's focus on endurance metrics like VO2 max (Hernández-Lougedo et al., 2023). It provides insights into the physiological demands of endurance running, which can be supported by the high carbohydrate intake typical of vegetarian diets, as noted in the manuscript (Ferreira et al., 2006). This paper's analysis of endurance runners' physiological fitness supports the manuscript's claim that vegetarian diets can enhance endurance performance through higher carbohydrate availability. It reinforces the need for well-planned vegetarian diets to meet the energy demands of endurance athletes, as discussed in the manuscript (Ahmed et al., 2022).

Singh, S., & Kumar, P. (2013). Physiological Differences Between Athletes of Selected Events in Track and Field – A Comparative Study. International Journal of Behavioral Social and Movement Sciences, 2(1), 235-241. Relevance to Manuscript: The manuscript discusses how vegetarian and non-

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vegetarian athletes exhibit similar performance in endurance and strength metrics (Craddock et al., 2016). This study compares physiological differences across track and field athletes, which is relevant to understanding how dietary patterns, including vegetarianism, influence performance across different athletic events. The study investigates physiological differences (e.g., aerobic capacity, muscle strength) among track and field athletes in different events, which aligns with the manuscript's comparison of vegetarian and non-vegetarian athletes' performance metrics. It provides data on how physiological traits vary by event, which can be linked to the manuscript's discussion of how dietary choices impact specific performance demands (e.g., endurance vs. strength). This paper's focus on physiological differences across athletic events supports the manuscript's findings that well-planned vegetarian diets can sustain performance across various sports, particularly endurance events, due to their carbohydrate-rich profile (Dmowska et al., 2024). Kalkal, A. K., & Singh, S. (2015). Effect of Slow Stretch & Hold, Ballistic, and Proprioceptive Neuromuscular Facilitation Method on Hamstring Flexibility. International Journal of Behavioural Social and Movement Sciences, 4(1), 16-25. Kaur, N., & Singh, S. P. (2021). Perceptive Consequences of the Respiratory Parameters of Middle- and Long-Distance Runners in Track and Field Athletes. Sports Science and Performance, 1, 8. This study examines respiratory parameters in runners, which could relate to the manuscript's discussion of endurance performance and physiological metrics like VO2 max (Hernández-Lougedo et al., 2023). However, it does not directly address dietary impacts, making it less central to the manuscript's core focus.

The study's focus on respiratory parameters could provide supplementary data on endurance performance, which is relevant to the manuscript's discussion of vegetarian diets' benefits for endurance athletes (Dmowska et al., 2024). Singh, S., & Kaur, L. (2014). Effect of different time of day on the coordinative ability of inter-university level female football players. International Journal of Physical Education, Sports, 2(1), 16-19. Das, S. C., & Singh, S. (2024). Chronotype and Athletic Performance in Different Time of Day. ShodhKosh: Journal of Visual and Performing Arts, 5(6), 463–467. These studies focus on coordinative ability and chronotype effects on performance, which are tangential to the manuscript's dietary focus. They could indirectly relate to performance optimization but do not address nutrition specifically. Singh, S. P. (2020). Effect of Slow and Soft Instrumental Music and Pop Instrumental Music on the running performance of track and field athletes. An International Multidisciplinary Quarterly Research Journal, 9(4), 7. This study examines music's effect on running performance, which is not directly related to dietary impacts but could be considered a complementary performance enhancement strategy.

Conclusions

The holistic health of athletes, encompassing physical, mental, and social dimensions, is fundamental to achieving optimal performance and sustaining long-term well-being. Sports psychology offers essential tools to enhance mental toughness, manage stress, and overcome psychological barriers, enabling athletes to perform at their peak. Interventions such as visualization, goal setting, and cognitive behavioral therapies are critical in fostering resilience and self-efficacy. Furthermore, telehealth provides a practical and stigma-reducing avenue for delivering timely care, particularly for student-athletes with demanding schedules. By prioritizing mental health alongside physical health, sports programs can create supportive environments that promote both athletic success and personal growth. Future efforts should focus on increasing awareness of psychological interventions, reducing stigma around mental health care, and integrating holistic health strategies to ensure athletes thrive both on and off the field.

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