PLANT-POWERED ATHLETES: A COMPARATIVE STUDY OF NUTRITIONAL INTAKE AND PHYSICAL OUTPUT PERFORMANCE

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Abstract

The increasing adoption of plant-based diets among competitive athletes has intensified interest in whether such dietary patterns can sustain high-level performance without compromising nutritional adequacy. This study compared the nutritional intake and physical performance of 300 competitive athletes in Metro Manila, divided equally into plant-powered and omnivorous groups. Using a comparative, quantitative, cross-sectional design, data were collected through 7-day food records, 24-hour dietary recalls, food frequency questionnaires, and standardized performance assessments of endurance, strength, and speed. Descriptive statistics, independent-samples t-tests, and Pearson correlation were applied at the 0.05 level of significance. Findings showed significant differences in dietary intake between groups. Plant-powered athletes consumed a higher proportion of carbohydrates, whereas omnivorous athletes consumed a higher proportion of protein and had markedly higher intakes of vitamin B12 and omega-3 fatty acids. Iron intake was slightly higher among plant-powered athletes. Despite these nutritional differences, no statistically significant differences were found in VO2max, squat 1-repetition maximum ratio, or 100-meter sprint time, indicating comparable endurance, strength, and speed outcomes across dietary patterns. Correlation analysis further revealed that higher carbohydrate intake was positively associated with VO2max, protein intake with strength, and omega-3 intake with time-to-exhaustion, while vitamin B12 showed a significant negative correlation with sprint time. The study concludes that a well-planned plant-based diet can support athletic performance comparable to that of an omnivorous diet, provided that key micronutrient gaps are addressed through careful dietary planning and appropriate supplementation.

Keywords: Plant-Powered Athletes, Nutritional Intake, Physical Output Performance, Endurance, Strength, Micronutrient Adequacy

1. Introduction

The rapid expansion of plant-based eating patterns has reshaped contemporary discussions in health, sustainability, and human performance. In recent years, vegetarian and vegan dietary patterns have moved beyond lifestyle preference and entered mainstream clinical and athletic discourse, prompting renewed interest in whether these diets can adequately sustain the physiological demands of competitive sport. Current professional guidance indicates that appropriately planned vegetarian dietary patterns can be nutritionally adequate for adults and may support long-term health; however, athletic populations represent a distinct nutritional context because training, recovery, and competition place unusually high demands on energy availability, protein turnover, glycogen restoration, and micronutrient sufficiency. As a result, the question is no longer whether plant-based diets are generally healthful, but whether they can consistently support high-level physical output under competitive conditions.

Athletes require a dietary pattern that does more than prevent deficiency; it must optimize adaptation to training, maintain lean tissue, and sustain repeated bouts of high-intensity effort. Protein intake is especially critical in this regard. The International Society of Sports Nutrition states that most exercising individuals need approximately 1.4 to 2.0 g of protein per kilogram of body weight per day to support training adaptations, recovery, and maintenance of fat-free mass.

Carbohydrate availability is equally central because it underpins muscle glycogen replenishment and supports prolonged or intense exercise. Thus, nutritional adequacy in athletes must be evaluated not only in terms of total intake, but also in terms of the quality, bioavailability, and performance relevance of specific nutrients across different dietary patterns.

Plant-based diets appear attractive in sport for several reasons. They are typically richer in complex carbohydrates, dietary fiber, polyphenols, and antioxidant-rich foods than conventional omnivorous diets, characteristics that may support glycogen stores, cardiometabolic health, and recovery from training stress. At the same time, the current evidence base does not support simplistic claims that vegan diets automatically enhance performance. A recent review of nutritional considerations for vegan athletes concluded that athletes can follow a vegan diet without an unavoidable detriment to performance. However, the available evidence does not show a consistent ergogenic advantage of vegan diets over omnivorous diets. This position suggests that dietary pattern alone is not the primary determinant of athletic success; rather, performance depends on whether the diet is carefully structured to meet sport-specific nutrient needs.

One of the most persistent criticisms of plant-based sports nutrition concerns protein quality. Compared with many animal-source proteins, single-source plant proteins often contain lower proportions of certain essential amino acids, particularly leucine, and may show lower digestibility. These characteristics have historically raised concern about whether plant-based athletes can support muscle protein synthesis, strength development, and recovery as effectively as omnivorous athletes. However, newer controlled evidence complicates this assumption. In a resistance-training trial comparing a high-protein plant-based diet with a protein-matched omnivorous diet, no significant between-group differences were found in strength or body composition outcomes when total protein intake was adequate. Such findings suggest that the practical issue is not whether protein comes from plants or animals per se, but whether total intake, amino acid composition, meal planning, and training context are sufficient to meet anabolic demands.

Micronutrient sufficiency remains the more delicate issue in plant-based athletic diets. Vitamin B12 is a particularly important concern because it is not naturally present in plant foods unless they are fortified, and recent reviews emphasize that oral supplementation is the safest strategy for maintaining adequate B12 status in plant-based populations. Iron is another critical nutrient because exercise increases iron demands, while the bioavailability of nonheme iron in vegetarian diets is lower than that of heme iron from mixed diets. The National Institutes of Health notes that vegetarians may need substantially more dietary iron than non-vegetarians due to these differences in iron absorption. Long-chain omega-3 fatty acids, especially DHA and EPA, also merit attention, although vegetarian-compatible algal oil supplements provide a viable source. For athletes, these micronutrients are not merely markers of general wellness; they are linked to oxygen transport, neuromuscular function, recovery, inflammation control, and overall training readiness.

Despite the growth of sports-nutrition literature, important gaps remain. Much of the available evidence has emphasized either endurance or resistance outcomes, often in small or highly controlled samples, and many studies do not simultaneously examine actual dietary intake alongside direct measures of athletic performance. This limitation matters because performance cannot be interpreted fully without understanding what athletes are actually consuming. A plant-based athlete with inadequate B12, iron, or total protein intake is nutritionally distinct from a plant-based athlete following a carefully planned, supplemented, high-protein regimen; similarly, an omnivorous athlete may consume animal products without necessarily achieving optimal sport nutrition. Comparative research that integrates macronutrient intake, key micronutrients, and objective performance metrics is, therefore, essential for generating practically useful conclusions rather than ideological ones.

The present study addresses this need by comparing the nutritional intake and physical output performance of plant-powered and omnivorous athletes in Metro Manila. Specifically, it examines dietary intake of macronutrients and selected micronutrients and relates these nutritional patterns to measurable indicators of endurance, strength, and speed. By doing so, the study extends the current debate from generalized claims about the superiority of vegans or omnivores toward a more evidence-based assessment of nutritional sufficiency and performance non-inferiority. It is particularly relevant in a setting where athletes, coaches, and sports dietitians require locally grounded evidence to guide dietary planning under real training conditions.

Ultimately, this inquiry is significant for both science and practice. Scientifically, it contributes to the growing body of literature evaluating whether dietary patterns predict performance independently of nutrient adequacy. In practice, it may help clarify whether plant-powered athletes can achieve comparable physical output to omnivorous athletes when dietary intake is appropriately managed, and identify the nutritional variables most strongly associated with performance. In this sense, the study does not frame plant-based and omnivorous diets as opposing ideologies, but rather as competing nutritional systems whose effectiveness depends on how well they meet the biological requirements for athletic performance.

2. Method

2.1 Research Design

This study employed a non-experimental, comparative quantitative research design to determine whether meaningful differences existed in nutritional intake and physical output performance between plant-powered athletes and omnivorous athletes. More specifically, the investigation adopted a cross-sectional approach because all dietary, anthropometric, and performance-related data were collected within a defined period rather than across multiple time points. This design was appropriate because the principal independent variable, namely dietary pattern, could not be manipulated or randomly assigned on ethical and practical grounds, given that participants had already been adhering to their respective diets for an extended period prior to recruitment. The comparative design enabled direct statistical examination of group differences in macronutrient and micronutrient intake, as well as in endurance, strength, and speed performance indicators. In this sense, the design was well-suited to the study's central purpose, which was not to establish causality in an experimental sense but to generate empirical evidence on whether dietary patterns were associated with measurable variation in athletic nutrition and performance outcomes under naturally occurring conditions.

2.2 Participants

The study participants were 300 competitive adult athletes from Metro Manila, composed of 150 plant-powered and 150 omnivorous athletes. They were selected through non-probability purposive sampling because the study required respondents who met highly specific inclusion criteria related to both training status and long-term dietary adherence. Eligible participants were between 18 and 40 years old, actively engaged in high-intensity training, and involved in competitive sports such as running, weightlifting, and team sports. To ensure stable dietary adaptation, participants in the plant-powered group were required to have consistently followed a strict vegan or plant-based diet for at least 1 year. In contrast, those in the omnivorous group were expected to have maintained a regular diet including animal products over the same period. Recruitment was facilitated through athletic clubs, university sports teams, and online athlete communities in Metro Manila, and each prospective participant underwent screening to verify compliance with the study criteria. The equal distribution of respondents across the two dietary groups strengthened the comparability of the dataset and improved the robustness of the inferential statistical procedures used in the investigation.

2.3 Instrumentation

The study utilized a multi-instrument quantitative protocol to capture both nutritional intake and physical output performance with sufficient rigor and comparability. Nutritional intake data were gathered through a structured 7-day food record, a 24-hour dietary recall, and a standardized food frequency questionnaire, all administered with the assistance of a registered dietitian to improve reporting accuracy and to verify long-term dietary patterns. These dietary records were subsequently encoded into a validated nutritional analysis software package to determine the mean daily intake of the major macronutrients. They selected key micronutrients, including vitamin B12, iron, and omega-3 fatty acids. For physical performance assessment, the study relied on calibrated and standardized testing equipment. Endurance was measured through VO2max and time-to-exhaustion procedures using laboratory-based metabolic testing equipment and a stationary bicycle; strength was assessed through 1-repetition maximum testing on major compound lifts using calibrated free weights; and speed was measured through standardized sprint trials using electronic timing gates on an athletic track. The use of these instruments ensured that both self-reported and performance-based variables were systematically captured and consistent with the study's comparative objectives.

2.4 Data Analysis

The collected data were processed and analyzed quantitatively using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics, particularly means and standard deviations, were first employed to summarize the nutritional and performance profiles of the two dietary groups. To test whether statistically significant differences existed between plant-powered and omnivorous athletes in daily nutrient intake and physical performance scores, the study used an independent-samples t-test at the 0.05 level of significance. In portions of the methodology draft, analysis of variance was also indicated as part of the inferential framework for testing differences in means where appropriate. In addition, Pearson's Product-Moment Correlation was used to determine the magnitude and direction of the relationship between selected nutritional variables and performance outcomes, thereby allowing the study to examine whether higher or lower nutrient intake was associated with better endurance, strength, or speed metrics. Through this analytical structure, the study addressed both its comparative and relational research objectives in a statistically coherent manner.

3 Results

The analysis of nutritional intake revealed clear, statistically significant differences between plant-powered and omnivorous athletes. In terms of macronutrients, the plant-powered group derived a significantly greater proportion of energy from carbohydrates ($M = 62.1\%$, $SD = 4.5$) than the omnivorous group ($M = 54.0\%$, $SD = 5.1$), with a computed t-value of 7.15 and a p-value of $< .001$. By contrast, omnivorous athletes obtained a significantly higher percentage of energy from protein ($M = 22.3\%$, $SD = 2.8$) than plant-powered athletes ($M = 18.5\%$, $SD = 2.1$), $t = -5.89$, $p < .001$. Total caloric intake also differed significantly, with omnivorous athletes reporting higher daily energy intake ($M = 3120$ kcal, $SD = 350$) than plant-powered athletes ($M = 2950$ kcal, $SD = 310$), $t = -3.51$, $p < .001$. These findings indicate that the two dietary groups were nutritionally distinct, with the plant-powered pattern characterized by stronger carbohydrate emphasis and the omnivorous pattern by greater protein density. The thesis interprets this pattern as consistent with contemporary sports nutrition thinking, which holds that high carbohydrate availability supports endurance work, whereas protein distribution remains central to muscular adaptation.

Likewise, marked differences were observed in key micronutrients. Plant-powered athletes reported substantially lower vitamin B12 intake ($M = 1.1$ µg, $SD = 0.8$) than omnivorous athletes ($M = 3.5$ µg, $SD = 1.2$), with $t = -12.90$ and $p < .001$. A similarly pronounced gap appeared in omega-3 fatty acid intake, with plant-powered athletes consuming 45 mg ($SD = 35$) compared with 210 mg (SD = 55) among omnivorous athletes, yielding $t = -9.44$ and $p < .001$. Interestingly, iron intake was slightly but significantly higher in the plant-powered group (M = 17.8 mg, SD = 3.2) than in the omnivorous group (M = 15.5 mg, SD = 3.5), with $t = 2.11$ and $p = .035$. The study discussed this result cautiously, noting that higher reported iron intake does not necessarily indicate better iron status, as plant-derived non-heme iron is generally less bioavailable than heme iron. Accordingly, the results suggest that plant-powered diets may successfully provide carbohydrate-rich fueling. However, they also require deliberate attention to micronutrients that are commonly limited in the absence of animal-source foods.

Despite these nutritional differences, the two groups demonstrated highly comparable physical output performance. Plant-powered athletes recorded a mean VO2max of 58.1 mL/kg/min (SD = 4.5), while omnivorous athletes posted 57.5 mL/kg/min (SD = 4.8), with no significant difference between groups, $t = 0.98$, $p = .328$. Strength performance was likewise similar, as measured by squat 1-RM to body weight ratio, where the plant-powered group obtained a mean of 1.95 (SD = 0.21) and the omnivorous group 1.98 (SD = 0.20), with $t = -0.65$ and $p = .517$. Speed outcomes followed the same trend: the 100-meter sprint times of plant-powered athletes (M = 11.85 s, SD = 0.40) and omnivorous athletes (M = 11.79 s, SD = 0.42) did not differ significantly, $t (1) = -1.11$, $p = .267$. These findings led to the retention of the second null hypothesis and support the thesis's central conclusion that a well-managed plant-powered diet does not inherently compromise endurance, strength, or speed in competitive athletes.

The correlation analysis offered a more nuanced interpretation, showing that athletic performance was more strongly associated with specific nutrient variables than with the dietary label alone. Carbohydrate intake showed a significant positive correlation with VO2max ($r = .285$, $p = .001$), indicating that greater carbohydrate availability was associated with greater aerobic capacity. Protein intake, in grams per kilogram of body weight, also correlated positively with the squat 1-RM ratio ($r = .352$, $p < .001$), reinforcing the importance of adequate protein provision for strength performance. In addition, omega-3 fatty acid intake was positively associated with time-to-exhaustion ($r = .211$, $p = .015$), while vitamin B12 intake showed a significant negative correlation with 100-meter sprint time ($r = -.188$, $p = .038$), suggesting that higher B12 intake was linked to faster sprint performance. The thesis interpreted these findings to mean that nutrient adequacy, rather than dietary identity, is the more decisive factor in optimizing athletic performance.

Taken together, the results demonstrate that plant-powered and omnivorous diets produce distinct nutritional profiles, yet these differences do not automatically translate into inferior or superior overall performance. Instead, the findings indicate that performance parity is achievable when athletes meet the physiological demands of training through appropriate nutrient planning. For plant-powered athletes, this implication is especially important: the diet can support competitive performance, but only when attention is given to protein sufficiency, strategic carbohydrate intake, and targeted micronutrient support, particularly for vitamin B12 and omega-3 fatty acids. Thus, the study advances an evidence-based position that athletic success is determined less by whether the diet is plant-based or omnivorous and more by whether it is nutritionally adequate, sport-specific, and consistently implemented.

4. Discussion

The present study's finding that plant-powered athletes consumed a higher proportion of carbohydrates but a lower proportion of protein than omnivorous athletes is well supported by current sports-nutrition literature. Contemporary reviews consistently describe vegetarian and vegan dietary patterns as richer in complex carbohydrates, fiber, and plant phytochemicals, while also requiring more deliberate attention to protein density, amino acid distribution, and total energy intake. Luna et al. (2024) concluded that well-planned vegetarian diets can meet athletic requirements, but only when macronutrient planning is intentional. Similarly, West et al. (2023)

emphasized that vegan athletes can perform without detriment, although spontaneous or poorly structured vegan diets may produce suboptimal intakes of protein and selected nutrients. The Academy of Nutrition and Dietetics likewise states that appropriately planned vegetarian and vegan patterns can be nutritionally adequate. However, they require individualized meal planning to reduce the risk of nutrient inadequacies (Raj et al., 2025). Thus, the nutritional profile observed in the present study is not anomalous; rather, it reflects a pattern already documented in the broader literature on plant-based sport nutrition.

The present study's significantly lower vitamin B12 and omega-3 intakes in the plant-powered group, together with slightly higher iron intake, also corroborate the current evidence base. Reviews focused on plant-based athletes identify vitamin B12, iron, calcium, vitamin D, zinc, and omega-3 fatty acids as nutrients most often requiring careful monitoring because their sources are limited in plant-based diets or their absorption is less efficient. Ayaz et al. (2024) and West et al. (2023) both stress that vitamin B12 and, in many cases, omega-3 fatty acids are difficult to obtain adequately from unsupplemented plant-based diets, while the lower bioavailability of non-heme iron complicates iron adequacy. Importantly, Nebl et al. (2019) found that recreational runners following vegetarian and vegan diets could maintain adequate vitamin B12, vitamin D, and iron status when supplementation and careful planning were used. This helps explain why the present study found higher reported iron intake in plant-powered athletes without assuming superior physiological iron status. In other words, the current study aligns with the literature, indicating that plant-based athletes may meet adequate intake targets. However, micronutrient sufficiency is more dependent on planning, fortification, and supplementation than in omnivorous diets.

The most important finding of the present study, however, is that there was no statistically significant difference between plant-powered and omnivorous athletes in endurance, strength, or speed. This result strongly agrees with existing comparative evidence. In a randomized crossover trial, Roberts et al. (2022) found no significant differences in running or strength outcomes between predominantly plant-based and omnivorous diets when protein intake remained within recommended ranges. Nebl et al. (2019) likewise reported no differences in exercise capacity among vegan, lacto-ovo-vegetarian, and omnivorous recreational runners. In resistance-focused contexts, Hevia-Larraín et al. (2021) showed that a high-protein plant-based diet supported comparable strength and muscle adaptations to a protein-matched omnivorous diet, and Monteyne et al. (2023) reached a similar conclusion for myofibrillar protein synthesis and hypertrophy during high-volume resistance training. More recently, López-Moreno et al. (2025) synthesized randomized trials and concluded that plant-based diets do not compromise upper-body, lower-body, or overall muscular strength compared with omnivorous diets. Taken together, these studies reinforce the interpretation that the absence of performance differences in the present investigation is consistent with the strongest available evidence: plant-based diets can support athletic performance when nutrient intake is sufficient.

The correlation results in the present study also align with established physiological principles, although they should be interpreted carefully. The positive association between carbohydrate intake and VO2max is biologically plausible because carbohydrate remains the primary fuel for moderate-to-high-intensity exercise and supports glycogen availability during endurance work. The positive link between protein intake and strength likewise aligns with evidence showing that high-protein diets, especially above 1.6 g/kg/day, support resistance-training adaptation when paired with progressive overload. At the same time, the relationships between omega-3 intake and time-to-exhaustion, and between vitamin B12 intake and sprint time, should be discussed with nuance. Current reviews suggest that omega-3 fatty acids may help reduce post-exercise inflammation and muscle damage, but direct performance improvements remain inconsistent. Similarly, vitamin B12 is clearly relevant to red blood cell formation and nervous system function. However, athletic outcomes are better interpreted in relation to actual biomarker status and supplementation practices than intake alone. Accordingly, the present study's correlations are best understood as physiologically credible associations that support careful nutrient management, rather than as proof that any single nutrient alone determines performance.

Overall, the present study is corroborated by the contemporary consensus in sports nutrition: dietary pattern matters, but nutrient adequacy matters more. The literature now consistently rejects the assumption that plant-powered athletes are inherently disadvantaged. Instead, it shows that performance comparability is achievable when energy intake, carbohydrate availability, protein quantity and quality, and high-risk micronutrients are appropriately managed. This makes the practical contribution of the present study especially valuable. It demonstrates, within a Metro Manila cohort, that plant-powered diets can support competitive endurance, strength, and speed outcomes, while also making clear that such diets require more structured nutritional planning than omnivorous diets. Therefore, the study contributes to an increasingly evidence-based view that athletic performance depends less on whether food is plant- or animal-derived and more on whether the diet is adequately designed to meet sport-specific physiological demands.

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