



Nutritional strategies for optimizing performance in karate athletes: A Review

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Abstract

Karate is a high-intensity combat sport characterized by intermittent bouts of explosive movements, rapid changes in direction, and technical precision. Athletes require optimal nutritional strategies to maintain energy availability, enhance performance, accelerate recovery, and achieve competition weight safely. Appropriate nutrition influences muscle glycogen stores, neuromuscular function, immune competence, and cognitive performance, all of which are essential during training and competition. This review summarizes current evidence regarding nutritional requirements for karate athletes, including macronutrient distribution, hydration, micronutrient intake, supplementation, and weight-management strategies. Carbohydrates remain the principal fuel for high-intensity exercise, while adequate protein intake supports muscle repair and adaptation. Healthy dietary fats contribute to hormone synthesis and overall health. Hydration before, during, and after exercise is crucial for maintaining performance and thermoregulation. Evidence-based supplementation, including caffeine, creatine monohydrate, beta-alanine, sodium bicarbonate, and dietary nitrates, may provide additional performance benefits when used appropriately. Conversely, rapid weight-loss practices frequently adopted before competition may impair physical and cognitive performance while increasing injury risk. Nutritional periodization, individualized meal planning, and recovery nutrition should therefore be integrated into regular training programs. Future research should focus on personalized nutrition, female karate athletes, and long-term health outcomes associated with weight management practices. Overall, scientifically designed nutritional strategies significantly contribute to improved athletic performance, faster recovery, and sustained competitive success in karate.

Keywords: Karate, sports nutrition, carbohydrates, protein, hydration, supplementation, weight management, recovery nutrition

Introduction

Karate is an Olympic combat sport requiring exceptional combinations of speed, agility, strength, flexibility, balance, technical precision, and tactical decision-making (Gawel *et al.*, 2025) ^[5]. Both kata and kumite demand repeated high-intensity efforts interspersed with brief recovery periods, placing considerable physiological stress on athletes (Gawel *et al.*, 2025) ^[5]. Success depends not only on technical skills and physical conditioning but also on optimal nutritional status (García-De Frutos *et al.*, 2025) ^[12].

Training sessions typically involve repeated bouts of explosive kicking, punching, jumping, defensive movements, and sparring, which rely heavily on phosphagen and anaerobic glycolytic energy systems (Gawel *et al.*, 2025; Ricci, 2025) ^[5, 12]. Consequently, adequate energy intake and appropriate nutrient timing become essential to replenish glycogen stores, facilitate muscle recovery, and maintain immune function (Ricci, 2025) ^[12]. Poor dietary habits can impair reaction time, reduce muscular endurance, delay recovery, and increase susceptibility to illness and injury.

Many karate athletes compete in weight-class divisions, making body composition management an integral component of performance preparation (Ricci, 2025) ^[12]. Unfortunately, rapid weight-cutting practices such as dehydration and severe caloric restriction remain common despite their documented negative effects on strength, cognitive function, and cardiovascular health (Ricci, 2025) ^[12]. Modern sports nutrition emphasizes gradual body composition modification through balanced dietary planning

rather than aggressive weight-loss methods (García-De Frutos *et al.*, 2025; Ricci, 2025) ^[4].

Recent advances in sports nutrition also highlight the importance of individualized nutrition plans, nutritional periodization, recovery strategies, and evidence-based supplementation (García-De Frutos *et al.*, 2025; Ricci, 2025) ^[4]. Appropriate intake of carbohydrates, proteins, healthy fats, vitamins, minerals, and fluids supports metabolic adaptations, muscle protein synthesis, immune function, and overall athletic performance (Ricci, 2025) ^[12]. Therefore, comprehensive nutritional strategies should form an essential part of every karate athlete's training program (García-De Frutos *et al.*, 2025) ^[4].

Nutritional Strategies for Karate Athletes

Carbohydrate Requirements

Carbohydrates are the primary fuel source during high-intensity intermittent exercise (Herrero Barceló, 2026) ^[6]. Muscle glycogen depletion reduces power production, reaction speed, and exercise capacity (Książek, 2025) ^[9]. Daily carbohydrate intake should generally range between 5–7 g/kg body weight during moderate training and 7–10 g/kg during intensive training or tournament preparation (Mohammadian, 2025; Ricci, 2025) ^[11, 12].

Athletes should consume carbohydrate-rich meals approximately three to four hours before competition to maximize glycogen storage (García-De Frutos *et al.*, 2025) ^[4]. Easily digestible carbohydrate snacks consumed 30–60 minutes before exercise may further improve performance. Following exercise, carbohydrate intake within the first hour

promotes rapid glycogen restoration and enhances recovery (Ricci, 2025) ^[12].

Excellent carbohydrate sources include whole grains, rice, oats, potatoes, fruits, vegetables, legumes, and dairy products.

Protein Requirements

Protein plays a fundamental role in muscle repair, recovery, immune function, and adaptation to resistance training (Ricci, 2025) ^[12]. Current sports nutrition guidelines recommend $1.4\text{--}2.0\text{ g/kg/day}$ of protein for combat sport athletes (Herrero Barceló, 2026; Ricci, 2025) ^[6, 12]. Protein intake should be distributed evenly across four to six meals throughout the day to maximize muscle protein synthesis (Książek, 2025) ^[9]. High-quality protein sources containing essential amino acids, particularly leucine, stimulate muscle repair more effectively (García-De Frutos *et al.*, 2025) ^[4]. Recommended protein sources include lean meat, poultry, fish, eggs, milk, yogurt, soy products, legumes, and whey protein. Following training, approximately $20\text{--}30\text{ g}$ of rapidly digestible protein consumed within one hour enhances recovery and muscle remodeling (Ricci, 2025) ^[12].

Dietary Fat

Dietary fats contribute to hormone production, vitamin absorption, cell membrane integrity, and long-duration energy supply. Approximately 20–35% of total daily energy should originate from healthy fats.

Unsaturated fats from nuts, seeds, olive oil, avocados, and fatty fish provide anti-inflammatory omega-3 fatty acids that may reduce exercise-induced muscle soreness and support cardiovascular health. Excessive saturated fat intake should be minimized.

Hydration Strategies

Even mild dehydration can reduce endurance, reaction time, concentration, and thermoregulation. Athletes should begin exercise in a well-hydrated state by consuming approximately 5–10 mL/kg body weight of fluids 2–4 hours before training.

During prolonged training sessions, regular fluid intake should replace sweat losses. Post-exercise hydration requires approximately 1.25–1.5 L of fluid for every kilogram of body weight lost during exercise.

Electrolyte-containing sports drinks become beneficial during extended or repeated training sessions exceeding one hour.

Micronutrients

Iron

Iron is an essential micronutrient for karate athletes because it plays a vital role in oxygen transport, energy production, and aerobic metabolism. It is a key component of hemoglobin and myoglobin, which transport oxygen to working muscles during high-intensity exercise. Iron deficiency can reduce aerobic capacity, increase fatigue, impair cognitive function, and delay recovery, ultimately compromising athletic performance. Female athletes, adolescents, and athletes following vegetarian or vegan diets are particularly vulnerable to iron deficiency due to increased physiological demands and lower dietary intake. Iron-rich foods such as lean red meat, poultry, fish, legumes, spinach, fortified cereals, and dried fruits should be included

regularly in the diet. Consuming vitamin C-rich foods alongside plant-based iron sources enhances iron absorption. Iron supplementation should only be undertaken following laboratory assessment and under professional supervision, as excessive iron intake may lead to toxicity and oxidative stress (Thomas *et al.*, 2016; Burke *et al.*, 2021) ^[2, 13].

Calcium

Calcium is fundamental for maintaining skeletal integrity, muscle contraction, nerve transmission, and blood clotting. In karate, where athletes are exposed to repetitive jumping, kicking, and impact forces, strong bones are essential for minimizing the risk of stress fractures and musculoskeletal injuries. Calcium also facilitates excitation-contraction coupling in skeletal muscles, enabling efficient force production during explosive movements. Insufficient calcium intake may impair bone mineral density, particularly in athletes experiencing low energy availability or restrictive dieting. Dairy products, fortified plant-based beverages, leafy green vegetables, sesame seeds, almonds, and small fish consumed with bones are excellent dietary sources. Adequate calcium intake, combined with sufficient vitamin D status, is critical for maximizing calcium absorption and supporting long-term bone health (Close *et al.*, 2019) ^[1].

Vitamin D

Vitamin D is increasingly recognized as an important nutrient for athletic performance because it regulates calcium and phosphorus metabolism, supports bone mineralization, and contributes to muscle strength and neuromuscular coordination. Adequate vitamin D status has been associated with improved muscle function, reduced injury risk, enhanced immune responses, and faster recovery following strenuous exercise. Since vitamin D is synthesized through skin exposure to sunlight, indoor training schedules, seasonal variations, and limited sun exposure may increase the risk of deficiency among athletes. Dietary sources include fatty fish, egg yolks, fortified dairy products, and fortified cereals, although sunlight remains the primary source. Vitamin D supplementation should be considered only after assessing serum vitamin D concentrations and consulting healthcare professionals (Maughan *et al.*, 2018) ^[10].

Magnesium

Magnesium is an essential mineral involved in more than 300 enzymatic reactions related to energy metabolism, muscle contraction, nerve function, and protein synthesis. During high-intensity karate training, magnesium supports ATP production, glucose metabolism, and electrolyte balance, all of which contribute to optimal exercise performance. Inadequate magnesium intake may result in muscle cramps, fatigue, weakness, reduced exercise capacity, and slower recovery. Athletes experiencing excessive sweating may have increased magnesium losses, emphasizing the importance of maintaining adequate dietary intake. Rich dietary sources include whole grains, nuts, seeds, legumes, leafy green vegetables, bananas, and dark chocolate. A balanced diet generally provides sufficient magnesium, and supplementation should only be recommended when dietary inadequacy or clinical deficiency has been confirmed (Kerksick *et al.*, 2018) ^[8].

Zinc

Zinc plays a crucial role in immune function, protein synthesis, wound healing, antioxidant defense, and cellular growth. For karate athletes, zinc contributes to muscle repair following intense training sessions, supports hormone production, and helps maintain immune competence during periods of heavy physical stress. Zinc deficiency may impair recovery, reduce appetite, increase susceptibility to infections, and negatively affect exercise performance. Good dietary sources include lean meat, seafood, poultry, dairy products, nuts, seeds, legumes, and whole grains. Because excessive zinc supplementation may interfere with copper absorption and immune function, supplementation should only be used when clinically indicated and under professional guidance (Thomas *et al.*, 2016) [13].

Vitamin C and Vitamin E

Vitamin C and vitamin E are powerful antioxidant vitamins that help protect athletes against exercise-induced oxidative stress resulting from repeated high-intensity training. Vitamin C contributes to collagen synthesis, immune defense, wound healing, and enhanced absorption of non-heme iron, while vitamin E protects cell membranes from oxidative damage by neutralizing free radicals. Together, these antioxidants may reduce muscle damage, inflammation, and delayed-onset muscle soreness, thereby facilitating recovery between training sessions and competitions. Natural dietary sources of vitamin C include citrus fruits, guava, kiwi, strawberries, tomatoes, and bell peppers, whereas vitamin E is abundant in nuts, seeds, vegetable oils, whole grains, and avocados. Although antioxidant-rich foods are strongly recommended, excessive supplementation may blunt beneficial exercise-induced adaptations; therefore, supplementation should only be considered after professional nutritional evaluation (Burke *et al.*, 2021; Maughan *et al.*, 2018) [2, 10].

Professional Assessment Before Supplementation

Routine micronutrient supplementation should not be considered a substitute for a balanced diet. Most karate athletes can meet their micronutrient requirements through a well-planned diet containing a variety of whole foods. Before initiating supplementation, athletes should undergo comprehensive nutritional assessment, including dietary analysis, medical history, biochemical testing, and evaluation by a qualified sports dietitian or healthcare professional. This individualized approach helps identify genuine deficiencies, prevents unnecessary supplementation, minimizes the risk of toxicity, and ensures that nutritional interventions effectively support health, recovery, and optimal athletic performance.

Ergogenic Supplements

Ergogenic Supplements Evidence-based supplements may enhance karate performance when combined with structured training (García-De Frutos *et al.*, 2025) [4]. Creatine monohydrate improves repeated high-intensity performance, muscular power, and lean body mass (Ricci, 2025) [12]. Caffeine enhances alertness, reaction time, concentration, and anaerobic performance when consumed approximately one hour before competition (García-De Frutos *et al.*, 2025; Ricci, 2025) [4]. Beta-alanine increases muscle carnosine concentration, delaying fatigue during repeated high-intensity efforts. Sodium bicarbonate improves buffering

capacity and may enhance repeated sprint performance. Dietary nitrates, commonly obtained from beetroot juice, may improve muscle efficiency and exercise economy (García-De Frutos *et al.*, 2025) [4]. Only supplements certified for safety and free from prohibited substances should be used.

Weight Management Many karate athletes attempt rapid weight reduction immediately before competition (Herrero Barceló, 2026; Mohammadian, 2025) [6, 11]. Common methods include dehydration, fasting, sauna use, and severe calorie restriction (Ricci, 2025) [12]. Although rapid weight loss may temporarily reduce body mass, it frequently impairs:

- Strength
- Power output (Książek, 2025) [9]
- Reaction speed
- Decision-making (Ricci, 2025) [12]
- Endurance
- Recovery
- Immune function

Gradual body composition management through balanced nutrition and structured training remains the safest and most effective strategy (García-De Frutos *et al.*, 2025; Herrero Barceló, 2026) [4, 6].

Recovery Nutrition

Recovery nutrition begins immediately after training or competition.

An ideal recovery meal should contain:

- Carbohydrates to replenish glycogen stores
- High-quality protein for muscle repair
- Adequate fluids and electrolytes
- Antioxidant-rich fruits and vegetables

Sleep quality also interacts with nutrition to optimize recovery, hormonal regulation, and athletic adaptation.

Conclusion

Nutrition represents one of the most influential yet modifiable determinants of karate performance. Appropriate intake of carbohydrates, proteins, healthy fats, micronutrients, and fluids supports energy production, muscle recovery, immune competence, and optimal body composition. Nutritional periodization tailored to training intensity and competition schedules further enhances physiological adaptation. Evidence-based supplementation, when used appropriately, may provide additional improvements in power, reaction time, and recovery. Conversely, unsafe rapid weight-loss practices should be discouraged because of their detrimental effects on health and athletic performance. Individualized nutrition programs developed by qualified sports nutrition professionals can optimize competitive success while promoting long-term athlete health. Future investigations should focus on personalized nutrition, female karate athletes, youth competitors, and the integration of nutritional strategies with advances in sports science and performance monitoring.

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