

Nutritional strategies for pediatric athletes: supporting healthy growth, development, and sports performance

Victor Felipe Villar Adam, Caio Silverio e Silva, Milena Gonçalves Mojuski * and Maria Gisele dos Santos

Department of Physical Education, Federal University of Paraná (UFPR), Curitiba, Paraná, Brazil.

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Abstract

The growing participation of children and adolescents in organized sports has increased the importance of adequate nutritional support during periods of growth and development. Unlike adults, young athletes face the dual challenge of meeting the energy demands of physical training while also supporting normal physiological growth processes. When nutritional intake is insufficient, there is an increased risk of low energy availability, which may negatively affect growth, bone development, pubertal maturation, and athletic performance.

This narrative review examines the nutritional requirements of pediatric athletes, with particular attention to energy availability, macronutrient distribution, micronutrient intake, and hydration strategies. A literature search was conducted using PubMed/MEDLINE, SciELO, and Google Scholar databases, focusing on studies published between 2010 and 2026. The selected evidence highlights the importance of adequate carbohydrate, protein, and fat consumption, as well as sufficient intake of calcium, vitamin D, and iron to support growth and athletic participation.

The findings also demonstrate that children present unique physiological characteristics that influence hydration status and thermoregulation during exercise. Therefore, nutritional recommendations for pediatric athletes should be tailored to their developmental stage rather than simply adapted from adult sports nutrition guidelines. The implementation of multidisciplinary educational programs involving healthcare professionals, coaches, and families may contribute to healthier sports participation and support long-term athletic development.

Keywords: Pediatric Athletes; Sports Nutrition; Energy Availability; Growth and Development; Micronutrients; Hydration.

1. Introduction

Participation in youth sports has increased substantially over recent decades. What was once primarily recreational has evolved into a more structured environment characterized by frequent training sessions, competitive schedules, and higher physical demands. As a result, children and adolescents are often exposed to workloads that require careful attention to their nutritional needs.

Regular physical activity provides numerous health benefits, including improvements in cardiovascular fitness, body composition, psychological well-being, and social development. However, young athletes differ from adults because they must simultaneously support athletic performance and the physiological processes associated with growth and maturation. During childhood and early adolescence, adequate nutrition is essential not only for exercise recovery but also for normal skeletal development, hormonal regulation, cognitive function, and overall health.

* Corresponding author: Milena Gonçalves Mojuski

One of the major concerns in pediatric sports nutrition is maintaining adequate energy availability. This concept refers to the amount of dietary energy remaining for essential physiological functions after accounting for the energy expended during exercise. When energy intake is insufficient to meet both training and developmental requirements, young athletes may experience a state of low energy availability. Over time, this condition can negatively affect growth patterns, delay pubertal development, impair bone health, and reduce athletic performance.

The nutritional management of pediatric athletes therefore requires a different approach from that used in adult populations. While many sports nutrition strategies are designed to maximize performance outcomes in mature athletes, nutritional recommendations for children must prioritize healthy growth and long-term well-being. Appropriate dietary planning should ensure an adequate supply of energy, macronutrients, micronutrients, and fluids to support both athletic participation and normal development.

Given the increasing involvement of children in organized sports and the growing recognition of nutrition as a key factor in athletic success and health, it is important to better understand the specific nutritional needs of this population. Therefore, the purpose of this review is to discuss current evidence regarding the nutritional requirements of pediatric athletes, with emphasis on energy availability, macronutrient intake, micronutrient status, hydration practices, and their relationship with growth, development, and sports performance.

2. Methodology

This study was developed as a narrative literature review aimed at analyzing current evidence regarding the nutritional needs of pediatric athletes and the role of adequate nutrition in supporting growth, development, and sports performance.

A comprehensive search of the scientific literature was conducted using the PubMed/MEDLINE, SciELO, and Google Scholar databases. The search focused on publications released between 2010 and 2026 in order to include both established recommendations and recent advances in pediatric sports nutrition research.

The search strategy combined descriptors and Medical Subject Headings (MeSH) terms related to the topic, including "Pediatric Athlete," "Sports Nutrition," "Energy Availability," "Youth Sports," "Growth and Development," "Macronutrients," and "Hydration." These terms were combined using Boolean operators to identify studies addressing the nutritional demands of physically active children.

The inclusion criteria comprised original research articles, prospective cohort studies, systematic reviews, narrative reviews, and position statements published by recognized organizations in the fields of sports medicine, nutrition, and pediatrics. Particular emphasis was given to studies involving children and early adolescents between 5 and 14 years of age who regularly participated in sports or structured physical training.

Studies focusing exclusively on adults, older adolescents, or clinical eating disorders unrelated to sports participation were excluded. Articles lacking scientific peer review or presenting insufficient methodological information were also omitted.

After the selection process, the available evidence was analyzed and organized according to key thematic areas, including energy availability, macronutrient requirements, micronutrient status, hydration strategies, and their implications for growth, health, and athletic performance in pediatric populations.

3. Literature review and discussion

3.1. Macronutrient Requirements and Energy Balance in Pediatric Athletes

Adequate energy intake is one of the most important factors for maintaining both healthy growth and optimal sports performance in children who engage in regular physical training. Unlike adult athletes, pediatric athletes must meet the energy demands associated with exercise while simultaneously supporting ongoing growth, tissue development, and physiological maturation.

Carbohydrates play a fundamental role as the primary source of energy during moderate- and high-intensity exercise. Sufficient carbohydrate intake helps maintain glycogen stores, delays the onset of fatigue, and supports training quality.

However, nutritional planning for children should not focus exclusively on carbohydrate consumption. A balanced dietary pattern remains essential to ensure overall health and development.

Dietary fats also contribute significantly to the nutritional status of young athletes. In addition to serving as an important energy source during prolonged physical activity, fats facilitate the absorption of fat-soluble vitamins such as vitamins A, D, E, and K. These nutrients are essential for immune function, bone health, vision, and normal growth processes. Excessive restriction of dietary fat may therefore compromise both health and athletic development.

Protein intake represents another critical component of pediatric sports nutrition. Proteins are required not only for muscle repair and recovery after exercise but also for the continuous growth and development that occur throughout childhood and adolescence. During these stages, the body undergoes significant structural changes that increase the demand for amino acids involved in tissue synthesis.

Current evidence suggests that physically active children generally benefit from daily protein intakes ranging from approximately 1.2 to 1.8 g/kg of body weight, depending on training volume, sport type, and individual developmental needs. Whenever possible, these requirements should be met through a varied and balanced diet consisting of high-quality protein sources such as dairy products, eggs, fish, poultry, legumes, and lean meats.

Rather than emphasizing isolated nutrients, nutritional strategies for pediatric athletes should focus on promoting a balanced dietary pattern capable of supporting energy balance, growth, recovery, and long-term health. Maintaining adequate energy availability remains particularly important, as chronic energy deficits may impair normal growth, reduce training adaptations, and increase the risk of future health complications.

3.2. Micronutrient Requirements: The Importance of Calcium, Vitamin D, and Iron

Although energy and macronutrient intake receive considerable attention in sports nutrition, micronutrients are equally important for supporting the health and development of pediatric athletes. During childhood and adolescence, periods characterized by rapid growth and physiological change, inadequate intake of essential vitamins and minerals may negatively affect both athletic performance and long-term health outcomes.

Among the nutrients of greatest concern are calcium and vitamin D, which play fundamental roles in bone formation and skeletal development. Children involved in regular sports participation place repeated mechanical stress on their bones through training and competition. When supported by adequate nutrition, this process contributes positively to bone strength and mineralization. However, insufficient calcium intake may compromise bone development and increase the risk of stress injuries and fractures.

Vitamin D works closely with calcium by promoting its absorption and utilization within the body. In addition to its contribution to bone health, vitamin D is involved in muscle function and immune regulation. Despite its importance, vitamin D insufficiency remains common among children and adolescents in various regions of the world, particularly among individuals with limited sun exposure. Therefore, ensuring adequate vitamin D status through appropriate dietary intake and healthy lifestyle habits is essential.

Iron is another nutrient that deserves special attention in pediatric athletes. This mineral is necessary for the production of hemoglobin and the transport of oxygen throughout the body. Inadequate iron stores may result in reduced exercise tolerance, increased fatigue, impaired concentration, and diminished athletic performance. Growing children often have elevated iron requirements due to expanding blood volume and tissue development, making them particularly vulnerable to deficiency.

The risk may be even greater among young athletes participating in endurance sports or those following restrictive dietary practices. For this reason, regular nutritional assessment and the inclusion of iron-rich foods such as lean meats, fish, beans, lentils, and fortified cereals are strongly recommended. Combining these foods with sources of vitamin C may further enhance iron absorption.

Overall, maintaining adequate micronutrient intake is an essential component of pediatric sports nutrition. Nutritional strategies should prioritize a varied and balanced diet capable of supplying the vitamins and minerals required for healthy growth, physiological function, and athletic participation.

3.3. Hydration and Thermoregulation in Young Athletes

Proper hydration is a critical aspect of sports performance and health in children and adolescents. Compared with adults, pediatric athletes present physiological characteristics that may increase their susceptibility to dehydration and heat-related complications during exercise.

Children generally have a higher body surface area relative to their body mass and may produce less sweat than adults under similar environmental conditions. These factors can influence the body's ability to regulate temperature efficiently during prolonged physical activity, particularly in hot and humid environments. As a result, maintaining adequate hydration before, during, and after exercise becomes especially important.

One challenge frequently observed in young athletes is the tendency to consume insufficient fluids during training sessions and competitions. Many children do not recognize thirst until a mild degree of dehydration has already developed. Even relatively small fluid losses may negatively affect physical performance, concentration, coordination, and overall exercise tolerance.

To reduce these risks, hydration should be encouraged as a planned component of training rather than relying solely on thirst perception. Coaches, parents, and sports professionals can help establish regular drinking opportunities before and throughout physical activity. Water is generally sufficient for most exercise sessions lasting less than one hour. However, during prolonged or high-intensity activities, beverages containing carbohydrates and electrolytes may assist in maintaining hydration and energy levels.

Environmental conditions should also be considered when developing hydration strategies. Training in hot weather may require more frequent fluid intake, scheduled rest periods, and additional monitoring for signs of heat stress. Educational initiatives aimed at athletes, families, and coaches can contribute significantly to the adoption of safe hydration practices.

By promoting appropriate hydration habits from an early age, sports programs can help protect young athletes from preventable health risks while supporting performance, recovery, and overall well-being.

4. Conclusion

Adequate nutrition is a fundamental component of health, growth, and athletic performance in pediatric athletes. Unlike adults, children and adolescents must simultaneously meet the physiological demands of training and the nutritional requirements necessary for normal growth and development. For this reason, nutritional recommendations for young athletes should always prioritize long-term health in addition to sports performance.

The evidence reviewed in this study highlights the importance of maintaining adequate energy availability and ensuring balanced consumption of carbohydrates, proteins, fats, vitamins, minerals, and fluids. Particular attention should be given to nutrients such as calcium, vitamin D, and iron, which play essential roles in bone development, metabolic function, and physical performance.

Hydration also represents a key aspect of pediatric sports nutrition. Because children present unique physiological characteristics related to thermoregulation and fluid balance, proactive hydration strategies are necessary to support safe participation in physical activity.

Promoting healthy nutritional habits among young athletes requires collaboration between healthcare professionals, nutritionists, coaches, teachers, and family members. Educational programs and evidence-based guidance can help prevent nutritional deficiencies, support healthy development, and encourage lifelong positive behaviors.

In conclusion, appropriate nutritional support should be considered an integral part of youth sports participation. By addressing the specific needs of growing athletes, it is possible to enhance performance while safeguarding health, development, and future well-being.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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