

Sports Nutrition and Gross Motor Skill Development in Youth Athletes: A Literature Review

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Abstract: This study explores the relationship between sports nutrition and gross motor skill development in young athletes, focusing on maintaining optimal nutrition levels. The primary issue identified is the lack of understanding of how nutrition impacts gross motor skills and athletic performance in children and adolescents. This study explores the relationship between sports nutrition and gross motor skill development in young athletes. The study aims to analyze how nutritional strategies affect gross motor skill development and overall health in young athletes. A qualitative descriptive research model, informed by a comprehensive literature review, was used. Literature was collected from reputable scientific databases using keywords such as "Sports Nutrition," "Gross Motor Skills," and "Youth Athletes." Data from ten relevant articles were analyzed to identify the impact of nutritional strategies on motor skill development. Results indicate that optimal nutrition plays a crucial role in enhancing gross motor skills, such as running, jumping, and coordination, which are essential for athletic performance. Macronutrients—carbohydrates, proteins, and fats—support energy levels, muscle growth, and recovery, while micronutrients like vitamins and minerals contribute to cognitive function and overall well-being. The study also reveals that socioeconomic factors affect access to nutritious food and motor skill outcomes. The conclusion underscores the importance of balanced nutrition for motor skill development and athletic performance. Recommendations for future research include employing longitudinal study designs to establish causal relationships, exploring synergistic effects of nutrients, and examining socioeconomic factors more deeply. Additionally, integrating nutrition education with physical training could offer practical solutions to enhance motor skill development in young athletes.

Keywords: Gross Motor Skills; Motor Skill Development; Nutritional Strategies; Sports Nutrition; Youth Athletes

Introduction

Sports nutrition and the development of gross motor skills are two important aspects that are interrelated in the world of athletics, especially in young athletes (Devrim-Lanpir et al., 2021). Nutrition not only serves as a provider of energy, but also as a key factor in supporting and maximizing the development of gross motor skills (Haris et al., 2024; Illahi et al., 2023; Insani et al., 2024). Gross motor skills include basic abilities such as running, jumping, throwing, and overall body coordination (Haris et al., 2024; Illahi et al., 2023; Insani et al., 2024). These abilities form the foundation for more specific and complex sports performance. In this case,

optimal nutrition plays a very important role in supporting such development (Likardo et al., 2023).

Young athletes are in a period of rapid growth, where their nutritional needs are very different compared to adults (Al Zaki et al., 2023; Amin et al., 2023; Oktadinata et al., 2024). They require the right balance of various macronutrients—carbohydrates, proteins, and fats—to support intense physical activity and the recovery process (Chinta et al., 2024; Illahi et al., 2023). Carbohydrates provide the main energy needed for physical activity, protein supports the growth and repair of muscle tissue, while healthy fats play a role in brain and nervous system health (Abreu et al., 2021; Gawrecki et al., 2019; Kim & Kim, 2020). Micronutrients

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such as vitamins and minerals are also very important, as they are involved in a variety of physiological processes that support performance and overall health (Petróczi et al., 2022; Richardson & Lovegrove, 2021).

In the developmental stages of children and adolescents, their nutritional needs not only serve to support physical growth, but also to facilitate the development of gross motor skills (Ferdian et al., 2023; Safitri et al., 2024). For example, protein deficiency can affect muscle development, while carbohydrate deficiency can result in decreased energy and performance during workouts and competitions (Burke, 2021; Gatterer et al., 2021). Additionally, deficiencies in certain vitamins and minerals, such as calcium and vitamin D, can affect bone health and muscle function (Glazkova et al., 2020; Ito et al., 2021; Pryhoda et al., 2021). Studies have shown that a good diet can accelerate the development of gross motor skills and help young athletes reach their maximum potential (Glazkova et al., 2020; Ito et al., 2021; Pryhoda et al., 2021). However, it is important to remember that nutrition is not the only factor that affects the development of gross motor skills. Other factors such as genetics, physical training, and social environment also play an important role. Therefore, a holistic approach that integrates nutrition, training, and environmental support will provide the best results in the development of gross motor skills.

Proper nutrition for young athletes involves more than just meeting basic nutritional needs. Nutrition programs should be designed to meet the specific physical demands of the sport they are engaged in. For example, a soccer athlete may need a higher carbohydrate intake to support stamina and endurance, while a weightlifter may need more protein to support strength and muscle mass (Fabre et al., 2022; Hawley & Leckey, 2015; Huang et al., 2020). Therefore, it is important for coaches, parents, and nutritionists to understand the specific needs of each athlete and design a meal plan accordingly. Poor nutrient intake can hinder the development of gross motor skills and potentially lead to long-term health problems. Malnutrition can lead to fatigue, decreased concentration, and an increased risk of injury. Therefore, it is important to regularly monitor and adjust the nutritional intake of young athletes.

In many cases, nutrition education also plays an important role in supporting the development of gross motor skills. Educating young athletes and their parents about the importance of healthy eating, hydration, and proper meal times can help them make better choices regarding the foods and drinks they consume. An effective educational program can increase awareness and knowledge about nutrition, which in turn can improve the performance and health of young athletes.

The importance of the relationship between nutrition and gross motor skills is also seen in various studies that show that young athletes who follow a healthy and balanced diet have better motor skill development compared to those who do not pay attention to their nutritional intake (Nusri et al., 2024; Rambe et al., 2024). For example, studies show that young athletes who consume enough protein experience significant increases in muscle mass and strength, which positively impacts their gross motor skills such as jumping and running. In addition, adequate carbohydrate intake helps them maintain energy during intensive training, which contributes to improved coordination and dexterity. Good mental health is essential for the development of gross motor skills, as stress and fatigue can affect their ability to learn and practice new skills (Biddle & Asare, 2011; Choudhury et al., 2020; Park, 2004). Nutrients that support brain health, such as omega-3 intake from fish and antioxidants from fruits and vegetables, can help maintain optimal cognitive function and improve focus and motivation. Sports nutrition for young athletes not only includes daily food and drink intake, but also involves recovery strategies after training. This is important to prepare the young athlete's body for the next training session and to prevent excessive fatigue (König et al., 2019; O'Connor et al., 2022; Webster et al., 2018). The aim of this research is to investigate how a balanced diet affects the development of gross motor skills, post-training recovery, and mental health in young athletes. Additionally, the study seeks to develop nutritional guidelines that can effectively enhance performance and gross motor skills in young athletes.

Method

The research process begins by systematically collecting literature from reputable scientific databases, including Scopus, Science Direct, and Google Scholar, using targeted keywords such as "Sports Nutrition," "Gross Motor Skills," "Youth Athletes,". Once the relevant literature is gathered, the next step involves reviewing key terms and concepts related in physical performance, and its implications for motor skill development in young athletes. The collected data is then organized and analyzed, taking into account details such as the author's name, topic, and results study. Articles that meet the established criteria are selected for more detailed examination. For more details, please see the Figure 1.

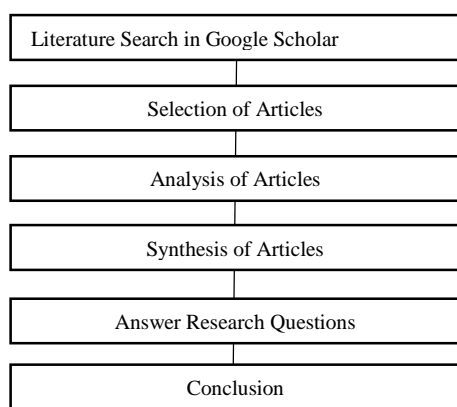


Figure 1. The Stages of the Research

Result and Discussion

Managing optimal nutrition in youth athletes involves employing dietary strategies, monitoring iron and vitamin intake, and adhering to a nutrition plan that supports both gross motor skill development and overall health. Athletes should balance their nutritional needs with their training regimen and make necessary adjustments to avoid deficiencies, ensuring effective performance and growth. This literature review will analyze 10 articles to explore how these nutritional strategies impact motor skill development. Detailed information is provided in Table 1.

Table 1. Summary of data descriptions

Author	Topic	Results
(Kwon et al., 2022)	Cross-sectional association of light sensor-measured time outdoors with physical activity and gross motor competency among U.S. preschool-aged children: the 2012 NHANES National Youth Fitness Survey	Research indicates that more outdoor time boosts gross motor skills in preschoolers, with girls showing a greater increase in physical activity compared to boys. Each additional 10 minutes outdoors correlates with improved object control skills but not locomotor skills. Nutrition supports this by providing essential energy and enhancing overall physical performance.
(Oliphant et al., 2024)	Microbiome function and neurodevelopment in Black infants: vitamin B12 emerges as a key factor.	Research highlights that vitamin B12 biosynthesis, linked to gut microbiota, positively impacts cognitive and motor skills in infants, especially boys. A healthy microbiome, such as one dominated by <i>Blautia</i> spp., supports motor development. Adequate nutrition, including vitamin B12, is crucial for young athletes' physical and motor skill growth.
(Gericke et al., 2023)	Relationships between moderate vigorous physical activity, motor- and health-related fitness and motor skills in children	Research shows only 66% of children aged 5-8 meet the 60-minute daily activity recommendation. Lower socioeconomic status negatively impacts the relationship between physical activity and fitness. Good nutrition supports physical activity and motor skill development, enhancing performance in skills like running and jumping and overall health.
(Chen et al., 2024)	Have the Fundamental Movement Skills of U.S. Children Changed?	Research from 1985 to 2019 shows initial improvement in fundamental movement skills (FMS) among young children, but a significant decline afterward. Good nutrition supports FMS by enhancing energy, endurance, and muscle growth, while also encouraging higher physical activity levels, crucial for developing complex motor skills.
(Latino et al., 2023)	Classroom-Based Physical Activity as a Means to Improve Self-Efficacy and Academic Achievement among Normal-Weight and Overweight Youth	Research shows that integrating physical activity into classroom routines boosts self-efficacy, academic performance, and reduces anxiety and BMI in adolescents, both normal weight and overweight. Combined with nutrition education, it enhances physical and cognitive skills, supporting better motor skill development and overall well-being in young athletes.
(Kwon & O'neill, 2020)	Socioeconomic and familial factors associated with gross motor skills among us children aged 3-5 years: The 2012 nhanes national youth fitness survey	Research shows 33.9% of children aged 3-5 in the US have below-average gross motor skills, with socioeconomic factors influencing outcomes. Good nutrition is crucial, as it provides energy, supports muscle growth, and enhances overall health, contributing to better motor skills and physical performance in young athletes.
(Pitchford et al., 2022)	Associations of fundamental motor skill competence, isometric plank, and modified pull-ups in 5-year old	Research on 121 five-year-olds shows a significant positive correlation between basic motor skills (FMS) and muscle fitness, as measured by TGMD-2, modified pull-ups, and plank performance. Good nutrition supports better motor

Author	Topic	Results
(Li, 2015)	children: An observational analysis of 2012 NHANES NYFS Study on athletes' food nutrition supplement scheme during tennis competition.	skill development and physical fitness, essential for long-term athletic performance and complex activities. Research shows that proper nutrition supplementation enhances physical fitness and tennis performance. Key nutrients, including carbohydrates, proteins, and vitamins, support recovery and glycogen replenishment. For young athletes, good nutrition boosts energy, effective recovery, and overall health, which improves motor skills and athletic performance.
(Jakše & Jakše, 2023)	a Four-Year Cycle Comparison of the Nutritional and Cardiovascular Health Status of an Elite-Level Female Artistic Gymnast: Case Study Report From Slovenia.	Research shows a female elite gymnast improved body composition, reduced fat, and altered nutrient intake over four years. Increased carbohydrate intake and regular supplementation, including vitamins and minerals, support athletic performance. Proper nutrition is crucial for young athletes' growth, motor skills development, and effective training program planning.
(Belton et al., 2014)	Youth-physical activity towards health: Evidence and background to the development of the Y-PATH physical activity intervention for adolescents	Research reveals that 67% of teens fall short of the recommended 60 minutes of daily physical activity, and 99.5% lack basic motor skills for their age. With 25% classified as overweight or obese, proper nutrition and skill development are crucial for improving physical activity and overall health.

The relationship between sports nutrition and gross motor skill development in youth athletes is a critical area of study, as evidenced by the diverse range of research findings. This literature review highlights that optimal nutrition plays a fundamental role in enhancing gross motor skills, such as running, jumping, and coordination, which are crucial for athletic performance. The reviewed studies underscore the importance of balanced nutrition in supporting physical activity and motor skill development. For instance, research by Kwon et al. (2022) shows that increased outdoor time correlates with improved gross motor skills, which is supported by adequate nutrition providing necessary energy. Similarly, Oliphant et al. (2024) found that vitamin B12, which is linked to gut microbiota health, plays a significant role in cognitive and motor skills development. These findings align with the understanding that specific nutrients are crucial for optimal growth and motor skills enhancement.

Gericke et al. (2023) further highlight the link between physical activity, motor skills, and health-related fitness. They reveal that while many children meet the recommended daily activity levels, socioeconomic factors can affect these outcomes. This underscores the role of good nutrition in supporting physical activity, which in turn enhances motor skills and overall health. The research by Chen et al. (2024) indicates a decline in fundamental movement skills among U.S. children over time, emphasizing the need for good nutrition to support energy, endurance, and muscle growth. Proper nutrition not only facilitates higher levels of physical activity but also supports the development of complex motor skills.

Socioeconomic factors, as explored by Kwon & O'Neill (2020), significantly influence gross motor skills. They highlight that children from lower socioeconomic backgrounds may have below-average motor skills, which can be mitigated by ensuring adequate nutrition. This finding is consistent with the broader understanding that socioeconomic status affects access to nutritious food and, consequently, motor skill development. Pitchford et al. (2022) demonstrate that fundamental motor skill competence is positively correlated with muscle fitness, suggesting that a well-balanced diet supports motor skill development. Proper nutrition helps in the development of muscle strength and overall physical fitness, which are essential for performing basic and advanced motor skills.

Li (2015) and Jakše & Jakše (2023) provide insights into how specific nutritional strategies can enhance athletic performance and motor skills. Li's study on tennis players emphasizes the role of carbohydrates, proteins, and vitamins in recovery and performance, while Jakše & Jakše highlight the impact of increased carbohydrate intake and regular supplementation on elite gymnasts. These studies reinforce the need for tailored nutrition plans that cater to the specific demands of different sports.

Belton et al. (2014) highlight the widespread lack of physical activity and basic motor skills among adolescents. They argue that proper nutrition, combined with skill development programs, is crucial for improving physical activity levels and overall health. Previous research provide a robust framework for understanding the relationship between nutrition and motor skill development. For example, the concept of

"nutritional ergonomics" suggests that optimal nutrition enhances physical performance by providing the necessary energy and nutrients for muscle function and recovery (Shearer et al., 2016). Additionally, research on the "developmental systems theory" posits that multiple factors, including nutrition, genetics, and environmental influences, interact to shape motor skill development (Dressino, 2017).

While the reviewed studies provide valuable insights, there are limitations to consider. Many studies rely on cross-sectional data, which cannot establish causation. Additionally, some studies do not account for the interaction between different nutrients and their combined effects on motor skill development. Variations in methodology and sample sizes also affect the generalizability of the findings. Moreover, socioeconomic and environmental factors are often complex and multifaceted, making it challenging to isolate the impact of nutrition alone. Future research should address these limitations by employing longitudinal study designs to establish causal relationships between nutrition and motor skill development. Studies should also explore the synergistic effects of different nutrients and their impact on motor skills. Additionally, research should consider the influence of socioeconomic and environmental factors in more depth to provide a comprehensive understanding of how these factors interact with nutrition to affect motor skill development. Investigating the role of nutrition education in promoting healthy eating habits and its impact on motor skill development is also crucial. Developing and testing intervention programs that integrate nutrition education with physical training could provide practical solutions for improving motor skills in young athletes.

Conclusion

The relationship between sports nutrition and gross motor skill development in young athletes is crucial for optimizing athletic performance and overall health. This literature review underscores that balanced nutrition is fundamental for enhancing gross motor skills such as running, jumping, and coordination. Adequate intake of macronutrients—carbohydrates, proteins, and fats—supports energy levels, muscle growth, and recovery, while micronutrients like vitamins and minerals contribute to cognitive function and overall well-being. Studies indicate that proper nutrition not only fosters better physical performance but also aids in the development of complex motor skills and improves mental health, which is essential for skill acquisition and practice. For instance, research highlights the importance of nutrients like vitamin B12 for motor and

cognitive development, and how deficiencies can impair physical performance and skill development. Socioeconomic factors also play a role, as they influence access to nutritious food and thereby impact motor skill outcomes. Despite valuable insights from current research, limitations such as reliance on cross-sectional data and variability in study methodologies suggest the need for more rigorous longitudinal studies to establish causation and explore the combined effects of nutrients. Future research should address these gaps and consider the interplay of socioeconomic and environmental factors with nutrition. Additionally, integrating nutrition education with physical training could offer practical solutions to enhance motor skill development in young athletes, ensuring they reach their ultimate potential in sports and overall health.

Author Contributions

This article was written by two contributors, Setyo Purwanto contributed to the writing of the introduction, methodology, literature review, results, and conclusions. Yovhandra Ockta contributed to the process of conceptualization, methodology, review, and finalization of articles and improvement of the content of the article.

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Conflict of Interest

The content of this article does not create a conflict of interest.

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