

Literasi gizi dalam olahraga: mengeksplorasi pengaruh spesifik jenis olahraga terhadap penggunaan suplemen ergogenik

Nutrition literacy in sports: exploring sport type-specific effect on ergogenic aids utilization

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Abstrak

Pendahuluan: Peran gizi dalam performa atlet sangatlah krusial. Namun, kebutuhan gizi dan tingkat literasi gizi bervariasi di antara atlet dari berbagai cabang olahraga dan dipengaruhi oleh berbagai faktor. Penelitian ini bertujuan untuk menyelidiki bagaimana literasi gizi bervariasi di antara atlet dari berbagai jenis olahraga, mengeksplorasi faktor-faktor yang memengaruhinya, serta mengkaji hubungan antara tingkat literasi gizi atlet dengan penggunaan suplemen ergogenik. **Metode:** Penelitian ini menggunakan tinjauan pustaka sistematis dengan mengikuti metode PRISMA. Pencarian dilakukan melalui basis data Scopus dan PubMed dengan menggunakan kata kunci seperti “nutrition literacy”, “nutrition knowledge”, “athletes”, “sports”, dan “ergogenic.” **Hasil:** Sebanyak 18 artikel terpilih menunjukkan bahwa literasi gizi mencakup pemahaman tentang makanan dan nutrisi untuk membuat keputusan diet yang tepat, yang sangat penting bagi kesehatan secara keseluruhan. Peningkatan literasi gizi mengarah pada perilaku hidup yang lebih sehat, yang sangat penting bagi atlet. Variasi literasi gizi di antara atlet dari berbagai cabang olahraga berperan penting dalam performa dan kesejahteraan mereka. Fokus pelatihan, tuntutan spesifik olahraga, karakteristik demografis atlet, dan penggunaan suplemen berkontribusi terhadap variasi ini, sehingga menekankan pentingnya program edukasi yang disesuaikan. Pemahaman tentang pengetahuan atlet mengenai suplemen dan praktik diet mereka memberikan wawasan berharga dalam mengoptimalkan performa atlet. Faktor-faktor seperti jenis olahraga, preferensi individu, dan ketersediaan informasi nutrisi memainkan peran penting dalam membentuk keputusan atlet terkait penggunaan suplemen ergogenik. **Kesimpulan:** Hubungan antara literasi gizi atlet dan penggunaan suplemen ergogenik menekankan pentingnya edukasi yang disesuaikan dan rencana gizi yang dipersonalisasi untuk mengoptimalkan performa dan kesejahteraan dalam olahraga.

Kata kunci: Literasi Gizi, Pengetahuan Gizi, Olahraga, Atlet, Ergogenik.

Abstract

Introduction: The role of nutrition in athletic performance is crucial. However, the nutritional requirements and literacy levels vary among athletes across different sports disciplines and influenced by various factors. Aims: This study investigates how nutrition literacy varies among athletes in different sports, exploring the factors, and examines the correlation between athletes' nutrition literacy levels and their use of ergogenic aids. **Methods:** This study employed a systematic literature review following the PRISMA method. Conducting searches across databases Scopus and PubMed using keywords including “nutrition literacy”, “nutrition knowledge”, “athletes”, “sports”, and “ergogenic.” **Results:** Total of 18 selected articles show that nutrition literacy involves understanding food and nutrition to make informed dietary decisions, crucial for overall health. Enhanced literacy leads to healthier behaviors, particularly important for athletes. Variations in nutrition literacy among athletes across different sports disciplines are crucial for performance and well-being. Coaching emphasis, sport-specific demands, athlete demographics, and supplement use contribute to these variations, highlighting the importance of tailored education programs. Understanding athletes' knowledge and utilization of these aids, as well as their dietary practices, offers valuable insights into optimizing athletes' performance. Factors such as the type of sport, individual preferences, and the availability of nutritional information play crucial roles in shaping athletes'

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decisions regarding ergogenic aid use. **Conclusion:** The connection between athletes' nutrition literacy and their use of ergogenic aids underscores the importance of tailored education and personalized nutrition plans for optimizing performance and well-being in sports.

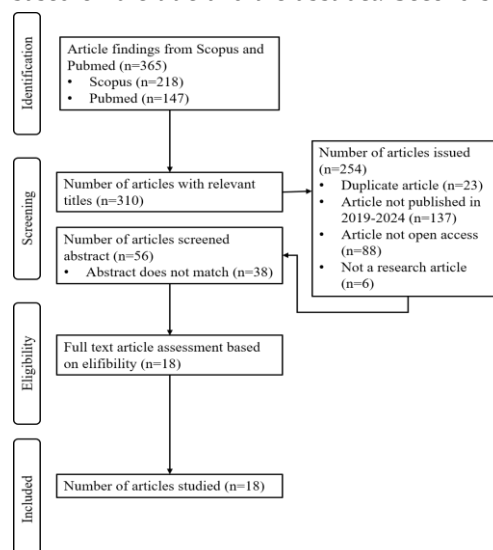
Keywords: Nutrition Literacy, Nutrition Knowledge, Sport, Athlete, Ergogenic.

INTRODUCTION

Nutrition plays a critical role in athletic performance, influencing factors like energy availability, recovery, and overall health. Research suggests that nutritional supplements containing essential vitamins and minerals can help prevent deficiencies and associated health issues, particularly for athletes involved in strenuous exercise [1]. There is a growing emphasis on prioritizing whole foods in sports nutrition, known as the "food first" approach. This approach underscores the significance of whole food nutritional products in aiding athletes to reach their performance objectives, with a focus on muscle recovery, endurance, and strength improvement [2]. Athletes across various disciplines require specific nutritional knowledge to optimize their training and competition. This knowledge can be termed nutrition literacy, encompassing the ability to understand, evaluate, and apply nutritional information to support personal dietary needs. Studies have shown that nutrition literacy includes both knowledge and skills related to food and nutrition, which are essential for making informed dietary choices [3]. Understanding nutritional priorities and practices is vital for developing evidence-based products that meet the specific needs of athletes [2]. However, the demands and nutritional requirements of different sports can vary significantly. Different sports place unique physiological and metabolic demands on the body, necessitating tailored nutritional strategies to support performance, recovery, and overall health [4]. A gymnast, for instance, will have distinct dietary needs compared to an endurance cyclist. Therefore, it is likely that nutrition literacy levels and their impact on supplement use (ergogenic aids) will differ across sports disciplines. On the other hand, athletes involved in team sports or high-intensity activities may have different nutritional demands. For instance, combat-sport athletes require specific nutritional strategies to support weight management, muscle recovery, and performance optimization [5]. Athletes engaging in high-intensity interval training may benefit from nutritional strategies that support rapid energy production and muscle recovery [6]. The purpose of this study is to identify how does nutrition literacy vary among athletes in different sports disciplines (e.g., team sports vs. individual sports, combat sports vs. endurance sports), what factors contribute to these variations (e.g., coaching emphasis, sport-specific demands, athlete demographics), Is there a correlation between an athlete's level of nutrition literacy and their utilization of ergogenic aids (both legal and illegal) within different sports disciplines.

METHODS

This study used a systematic literature review using the SCOPUS and Pubmed online databases, guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method and protocol.. [7] conducted by one author (DPS). We included English full-text articles published between January 1st, 2019, and May 31st, 2024. We were used the search terms "nutrition literacy", "nutrition knowledge", "athlete", "sport", and "ergogenic" and then combined them with the logical operator "AND". Further, the first step of the article selection process was a selection based on the title and the abstract. Second step was duplicate and full-article



check to meet the inclusion criteria. The last step of the article selection process was carefully analyzing the eighteen eligible articles in a critical appraisal process presented in Table 1. Table 1 presents the author's name, year of publication, research aims, data collection instruments, methods, and outcomes.

Figure 1. Flow Chart of Systematic Literature Review

RESULT

Based on the search results applying preset keywords and inclusion criteria, a total of N = 365 potential articles were originally obtained from two major databases: Scopus (N = 218) and PubMed. After the title screening procedure, there were 310 articles with suitable titles. After deleting duplicate articles (n = 23), publications not published between 2020 and 2024 (n = 137), articles without open access availability (n = 88), and articles classed as non-research articles (n = 6), 254 articles remained for further analysis. Subsequent abstract screening yielded 56 papers, 38 of which had abstracts that did not fulfill the preset requirements.

Tabel 1. Summary of article's result of nutrition literacy in sports across disciplines and its impact on ergogenic aids utilization

Reference	Aim	Instrument	Study Design	Results
[2]	To understand the nutritional priorities, practices, and preferences of athletes and active individuals to guide the development of new food products in the sports nutrition sector.	• Comprehensive Online Survey Questionnaire • Focus Group Sessions • Use the Qualtrics platform with 34 questions ▪ multiple-choice questions ▪ rating scale questions ▪ rank order questions ▪ matrix scale questions	Cross-sectional	• Athletes prioritize "enhanced muscular recovery" in sports nutrition products. • Whole food products, food bars, and powder-based products are preferred for both recovery and performance. • Preferences did not vary significantly based on activity levels. • The results emphasize the importance of aligning product characteristics with athletes' needs in the sports nutrition sector.
[5]	To investigate the motives behind female combat-sport athletes' participation, explore the impact of health correlates on their well-being, and examine their experiences of sexual harassment.	• A questionnaire on health behavior and mental health, diet registration, and a DXA-scan for body composition analysis. • Validated questionnaires on body appreciation, low energy availability, symptoms of eating disorders, and experiences of sexual harassment.	Cross-sectional	The study found that many female combat-sport athletes experienced injuries, low energy availability, and inadequate nutritional intake. Additionally, a significant number reported experiencing sexual harassment.
[19]	Develop and implement a nutrition knowledge questionnaire specifically tailored for ultra-endurance athletes, assess the athletes' sports nutrition knowledge using the questionnaire, and evaluate the construct validity and test-retest reliability of the questionnaire	The instrument used in the study is called the ULTRA-Q, a modified sports nutrition questionnaire designed to assess the nutrition knowledge of ultra-endurance athletes. It consists of questions covering five domains: nutrients, fluid, recovery, body composition, and supplements.	Cross-sectional	The study found that ultra-endurance athletes had a reasonable level of nutrition knowledge, with no significant differences between genders or athlete groups. Athletes primarily obtained nutrition information from other athletes. The ULTRA-Q questionnaire showed good validity and reliability for assessing nutrition knowledge in this population
[17]	The aim of the study was to assess the sport nutrition knowledge, dietary practices, and sources of nutrition information in NCAA Division III collegiate athletes.	The instrument used in the study was a validated 49-item sport nutrition knowledge questionnaire, broken down into six sections related to carbohydrate, protein, fat, hydration, micronutrients, and weight management.	Cross-sectional	The study found that NCAA Division III collegiate athletes had a mean sport nutrition knowledge score of 6.4 out of 49. Male and female athletes showed similar scores across different sections of the questionnaire. Additionally, a low percentage of athletes had received counseling from a dietitian or nutritionist, or had taken a college-level nutrition course

Reference	Aim	Instrument	Study Design	Results
[20]	The study aimed to investigate the impact of sport nutrition knowledge on body composition and perceptions of dietary requirements in collegiate athletes, particularly focusing on NCAA Division III women athletes.	The instrument used in the study to assess sport nutrition knowledge was an electronic validated sport nutrition knowledge questionnaire	Cross-sectional	The results revealed that athletes that were more knowledgeable about sport nutrition had lower body fat percentages and fat mass values. Additionally, athletes underestimated their energy and macronutrient requirements, particularly carbohydrates, highlighting a need for improved nutrition education.
[21]	The aims of the study were to assess the sport nutrition knowledge, attitudes, sources of information, and dietary habits of sport-team athletes, and to identify areas for improvement in nutrition education and support for these athletes.	The instrument used in the study was the Knowledge-Attitudes-Practices (KAP) manual, which assessed nutrition-related knowledge, attitudes, and practices among the sport-team athletes	Cross-sectional	The study involved 506 participants from different groups, with findings showing variations in nutrition knowledge scores among the groups. Differences were observed in attitudes towards nutrition, sources of information, and dietary practices. Women were more represented in the subsample for Phase II, and there were differences in nutrition knowledge scores between the subsample and the rest of the athletes.
[23]	The study aimed to enhance nutrition knowledge and dietary intake among young endurance athletes through education sessions and a mobile food application.	The validated nutrition knowledge questionnaire consisting of 78 true/false statements, focusing on nutrition recommendations for endurance athletes, dietary supplements, fluid balance, hydration, and energy intake.	Cross-sectional	Of the 79 participants, 62 completed the nutrition knowledge questionnaires, and 67 completed food diaries. The mean age of the athletes was 18.0 years, with 56% male and 44% female participants. Significant improvement in nutrition knowledge scores was observed throughout the study.
[24]	Evaluate the nutrition knowledge status of Division I Basketball players and coaches in Lebanon, assess the prevalence of inadequate knowledge, identify knowledge gaps, explore main sources of nutrition information, and determine independent predictors of inadequate knowledge among D1B athletes and coaches.	The study utilized a questionnaire to collect data from Division I Basketball players and coaches in Lebanon. The questionnaire included questions on nutrition knowledge, available resources, and perceptions related to sports nutrition.	Cross-sectional	The results showed that a significant percentage of Division I Basketball players and coaches in Lebanon had inadequate nutrition knowledge. Lack of nutrition education was found to be independently associated with inadequate knowledge among the players. The study highlights the need for sports clubs in Lebanon to consider hiring dietitians or conducting nutrition education campaigns to improve the athletes' physical health and performance.
[25]	Identify the determinants influencing coaches' intentions to recommend specific sports nutrition practices to their athletes and to provide insights for supporting coaches in promoting optimal sports nutrition practices.	A web-based questionnaire based on the Theory of Planned Behavior. It included items on attitudes, subjective norms, perceived behavioral control, past behavior, and nutrition knowledge.	Cross-sectional	The study found that subjective norm and perceived behavioral control were significant determinants of coaches' intentions to provide recommendations on sports nutrition to their athletes. These factors should be considered in future interventions to improve coaches' sports nutrition guidance.
[26]	Assess the awareness and knowledge of medical issues related to female athletes, specifically focusing on the Female Athlete Triad and Relative Energy Deficiency in Sport (RED-S), among track and field coaches in Japan. The researchers also aimed to identify any factors that may influence coaches' awareness and knowledge of these medical issues.	This study employed an online anonymous survey conducted by email to track and field coaches in Japan.	Cross-sectional	In this study, 412 track and field coaches participated, with 89.6% being male and 10.4% female. Female coaches showed greater awareness of the Female Athlete Triad and had better access to physicians for gynecological issues compared to male coaches. Coaches with more experience tended to be more aware of the Triad and RED-S.
[27]	This study aimed to assess the dietary intake and nutritional status of CrossFit-trained individuals through anthropometric measurements and nutritional analysis, providing insights into their dietary habits and potential nutritional needs.	The instrument used in this study to assess dietary intake was a standardized 3-day food record.	Cross-sectional	The body composition analysis of CrossFit-trained participants showed normative values, with body fat percentages of 20.3% for females and 13.7% for males. The study also highlighted potential issues of low energy intake compared to energy demands among the participants.

Reference	Aim	Instrument	Study Design	Results
[28]	This study aimed to assess the energy requirements and nutritional needs of rock-climbing athletes in Buleleng Regency to provide valuable recommendations for feeding.	The instruments used in the study included measurements for BMI, calculations for BMR and SDA, interviews for physical activity assessment, and discussions on daily food intake.	Cross-sectional	The study found that the rock climbing athletes in Buleleng Regency had a normal BMI, with an average energy requirement of 4568.45 calories per day.
[29]	The study aimed to assess the knowledge and attitudes of Arab Olympic athletes and coaches towards dietary supplements in preparation for the Tokyo 2020 Olympic Games.	The Knowledge, Attitude, and Practice (KAP) Strategy was used as the instrument to assess the nutritional knowledge, attitude, and practices of athletes and coaches regarding dietary supplements in the study.	Cross-sectional	The results showed significant differences in the knowledge, attitudes, and practices of elite athletes and coaches based on demographic variables such as gender, sport, experience, and income. Coaches with more than 10 years of experience demonstrated higher levels of correct answers, while income levels also influenced the participants' practices regarding dietary supplements.
[30]	Explore the challenges faced by Australian female athletes when training and competing with menstrual symptoms, including the impact of these symptoms on performance and the role of coaches in managing them.	The instrument used in the study was an anonymous 36-item questionnaire developed by the research team in collaboration with female athletes and senior academics at the New South Wales Institute of Sport (NSWIS).	Cross-sectional	Responses were collected from 124 Australian female athletes aged 16-45. Commonly reported menstrual symptoms included period pain and pre-menstrual symptoms, contributing to fatigue and perceived reductions in performance. Heavy menstrual bleeding was associated with increased fatigue. Most athletes did not alter training based on the menstrual cycle, and the majority did not discuss menstruation with their coaches.
[31]	Investigate the preferred sources of sports nutrition information among Australian team sports athletes and explore how these preferences may impact their nutrition knowledge.	The instrument used in this study was an online, validated sports nutrition knowledge questionnaire completed by elite and non-elite Australian team sports athletes.	Cross-sectional	The results showed that Australian team sports athletes prefer dietitians, the internet, and nutritionists for sports nutrition information. Preferences for information sources did not significantly influence nutrition knowledge scores.
[32]	This study aimed to assess the sports nutrition and food knowledge of Malaysian university athletes, focusing on macronutrients, micronutrients, hydration, and food intake periodicity.	The questionnaire covered topics related to macronutrients, micronutrients, hydration, and food intake periodicity.	Cross-sectional	The study found that Malaysian university athletes had inadequate sports nutrition and food knowledge, with more than half scoring below 60%. This highlights the need for improved nutrition education programs to enhance athletes' dietary practices and overall health.
[33]	This study aimed to investigate the relationship between athletes' knowledge of nutrition and dietary supplementation (KN&DS) and their actual dietary supplement use (DSU) in professional team-sport players from Southeastern Europe during the competitive season.	The validated questionnaires to assess various factors related to athletes' knowledge of nutrition and dietary supplementation, including their self-perceived competence (S/KN&DS) and objectively evaluated knowledge (O/KN&DS).	Cross-sectional	The study found that athletes with higher scores in both self-perceived and objectively evaluated knowledge of nutrition and dietary supplementation were more likely to use dietary supplements. Self-perceived competence was a stronger predictor of dietary supplement use than objective knowledge. The research highlighted the importance of targeted education for athletes on sports nutrition and dietary supplements, especially in sports with a high prevalence of supplement use.
[34]	Investigate the relationship between nutrition knowledge, practice, supplement use, and nutrient intake with athletic performance among Taekwondo players in Nepal.	The semi-structured questionnaires, 24-hour dietary recall for nutrient intake assessment, anthropometric measurements, and handgrip dynamometer for assessing handgrip strength as an indirect measure of athletic performance.	Cross-sectional	Among the 293 Taekwondo players in Nepal, more than half had poor nutrition knowledge and practice scores. Their nutrient intake was lower than the recommended levels for athletes. Most participants did not use supplements, with protein powder being the most commonly consumed. The study highlighted a significant association between poor nutritional knowledge and practice scores among the athletes.

DISCUSSION

Nutrition Literacy Variation Among Athletes in Different Sports Disciplines

Nutrition literacy refers to the knowledge, skills, competencies, and awareness individuals have regarding food, nutrition, and the food system. It involves the capacity to access, understand, evaluate, and apply nutritional information to make informed decisions related to food choices and dietary behaviors [8-11]. Nutrition literacy goes beyond mere knowledge and includes practical skills necessary to plan, manage, select, prepare, and consume foods that meet nutritional needs and support overall health [10]. Studies have shown that nutrition literacy plays a crucial role in influencing dietary behaviors, food choices, and overall health outcomes. Individuals with higher levels of nutrition literacy are more likely to make healthier food choices, adhere to balanced diets, and exhibit improved dietary behaviors [8, 12]. By enhancing nutrition literacy through educational interventions and programs, individuals can develop the knowledge and skills needed to make informed decisions about their diets, leading to improved health outcomes and reduced risk of nutrition-related diseases [13-15]. Athletes' nutrition literacy is crucial for their overall health, performance, and well-being. Several studies emphasize the significance of nutrition literacy among athletes and active individuals highlight the importance of understanding athletes' nutritional priorities and practices for developing evidence-based food products [2]. Moreover, emphasize how important it is for female combat-sport athletes to have greater health and nutrition awareness in order to protect their emotional and physical health [16]. Research has shown that while ultraendurance athletes generally possess a reasonable level of nutrition knowledge, there is variability among individuals, highlighting the necessity for tailored nutrition education [17]. The importance of increasing athletes' food and nutrition knowledge to comprehend their dietary preferences and priorities has been emphasized. [2]. Understanding sports nutrition enables athletes to optimize their training demands, enhance performance, and facilitate recovery [17]. Furthermore, nutrition literacy not only impacts performance but also extends to mental health and well-being in athletes. Factors such as nutrition and mental health literacy play a role in the relationship between stress exposure and mental health outcomes in elite sports [18]. This highlights the comprehensive approach required to address athletes' nutritional needs adequately. In conclusion, athletes' nutrition literacy is a multifaceted aspect that influences various aspects of their athletic endeavors. Targeted nutrition education programs, assessment of nutrition knowledge, and understanding athletes' priorities are vital steps in enhancing athletes' nutrition literacy and optimizing their overall well-being.

Factors Contribute to Variation of Nutrition Literacy Among Athletes in Different Sports Disciplines

Factors contributing to the variation of nutrition literacy among athletes in different sports disciplines are multifaceted and crucial for optimizing athletic performance and overall well-being. Blennerhassett and colleagues [19] highlights the variability in nutrition knowledge among ultra endurance athletes, emphasizing the need for targeted nutrition education to address individual differences. Jagim and colleagues [20] delve into how sport nutrition knowledge influences body composition and dietary perceptions among collegiate athletes, showcasing the importance of informed dietary choices in achieving body weight goals. Additionally, Vázquez-Espino et al (2022), the significance of nutrition knowledge in establishing proper eating habits for athletes, underscoring its critical role in supporting athletic endeavors [21]. Riviere et al (2021) sheds light on the nutrition knowledge of collegiate athletes in the United States and the impact of sports dietitians on related outcomes, emphasizing the need for targeted interventions to improve nutrition literacy among athletes [22]. Heikkilä et al (2019) conducted research highlighting the positive effect of nutrition education interventions on enhancing nutrition knowledge among young endurance athletes [23].

This underscores the importance of educational programs in improving athletes' comprehension of nutrition, crucial for optimizing performance and overall health. Additionally, Boumosleh et al (2021) emphasize the significance of adequate nutrition knowledge in professional basketball athletes and coaches, linking it to optimal athletic performance and recovery [24]. Blennerhassett et al (2019) found that while ultra endurance athletes generally possess reasonable nutrition knowledge, there is variability among individuals, suggesting a need for targeted education to address these differences [19]. Jagim et al (2021) explore how sport nutrition knowledge influences body composition and dietary perceptions among collegiate athletes, highlighting the importance of informed dietary choices in achieving body weight goals [20]. Vázquez-Espino et al (2022) stress the critical role of nutrition knowledge in establishing proper eating habits for sport-team athletes, emphasizing its importance in supporting athletic endeavors [21]. Factors that contribute to athletes' nutrition knowledge encompass a wide array of elements, including coaching emphasis, sport-specific demands, and athlete demographics. Coaching plays a significant role in shaping athletes' understanding of nutrition [25, 35]. Coaches

who possess adequate nutrition knowledge can effectively guide athletes on proper dietary practices, impacting their performance and overall health. Additionally, the study by Tsukahara et al (2023) indicates that coaches with more experience tend to be more aware of medical issues related to athletes, emphasizing the importance of coach expertise in addressing nutrition-related concerns [26]. Sport-specific demands also influence athletes' nutrition knowledge, as seen in research by Gogojewicz et al. 2020 and Mashuri et al. 2022. Understanding the dietary requirements specific to different sports disciplines is crucial for athletes to optimize their nutritional intake and support their training and competition needs. Moreover, athlete demographics, such as age, gender, and level of experience, can impact nutrition knowledge [29, 36]. Tailoring nutrition education programs to cater to the diverse demographics of athletes can enhance their comprehension and application of nutritional principles. Furthermore, factors like the use of nutritional supplements, as explored in studies by Armour et al (2020) can influence athletes' nutrition knowledge. Coaches and other sources of information play a crucial role in providing guidance on supplement use and nutritional practices [30]. In conclusion, the variation in nutrition literacy among athletes in different sports disciplines underscores the importance of tailored nutrition education programs to enhance performance, recovery, and overall health. Addressing individual differences in nutrition knowledge through targeted interventions can empower athletes to make informed dietary choices, optimize their performance, and achieve their athletic goals.

Correlation Between an Athlete's Level of Nutrition Literacy and Their Utilization of Ergogenic Aids (Both Legal and Illegal) Within Different Sports Disciplines

Exploring the relationship between an athlete's level of nutrition literacy and their utilization of ergogenic aids (both legal and illegal) across different sports disciplines, a thorough review of the literature is crucial. The use of ergogenic aids, substances or techniques employed to enhance athletic performance, is widespread among athletes in various sports. Understanding how an athlete's nutrition literacy impacts their decision to use ergogenic aids can offer valuable insights into performance enhancement and athlete well-being. A pertinent reference by Gonzales-Krapp et al (2024) investigates the use of ergogenic nutritional aids by elite athletes from Peru competing at the international level [37]. Klein et al (2021) evaluates the sport nutrition knowledge, dietary practices, and sources of nutrition information among NCAA Division III collegiate athletes [17]. This study could offer valuable insights into athletes' nutrition literacy and its potential impact on their use of ergogenic aids. Gonzales-Krapp et al (2024) reveals a high level of knowledge among elite athletes regarding ergogenic nutritional aids, with 99.6% of respondents familiar with these aids and 93.7% admitting their use [37]. This study sheds light on how athletes' nutrition literacy influences their decision to utilize ergogenic aids in different sports disciplines. Additionally, the study by Ferrada-Contreras et al (2023) explores the impact of co-supplementation with beetroot juice and other nutritional supplements on sports performance, indicating athletes' constant search for strategies to enhance physical performance, including the incorporation of sports supplements [38]. Moreover, the research by Erumcu (2023) evaluates the use of nutritional ergogenic aids in athletes across different sports branches, highlighting that one-third of the athletes (36.0%) use these aids [39]. This study offers insights into how athletes' nutrition literacy influences their decision to use ergogenic aids based on the specific demands of their sports disciplines. Wax et al (2021) delves into the utilization of creatine as an ergogenic aid by athletes aiming to enhance sport and exercise performance [40]. Understanding how athletes in team sports with varying levels of nutrition knowledge use creatine can shed light on the connection between nutrition literacy and ergogenic aid utilization. Another study by Trakman et al (2019) investigates the preferred sources of nutrition information among Australian team sports athletes, including dietitians and nutritionists [31]. This research can provide insights into how athletes in team sports access nutritional guidance and how their nutrition knowledge influences their selection of ergogenic aids. Additionally, the research conducted by Azizam et al (2022) examines sports nutrition and food knowledge among Malaysian university athletes, emphasizing the potential impact of nutrition knowledge on athletes' dietary intake and athletic performance [32]. This study offers valuable insights into how nutrition literacy influences the use of ergogenic aids in team sports.

Furthermore, Viribay et al (2020) focuses on the effects of arginine supplementation on athletic performance based on energy metabolism [41]. Understanding how athletes in individual sports utilize arginine as an ergogenic aid based on their nutrition knowledge can provide insights into the relationship between nutrition literacy and ergogenic aid utilization. Sekulic et al (2019) examines the association between nutrition knowledge and dietary supplement use among professional athletes involved in team sports [33]. This research can offer valuable insights into how athletes' nutrition knowledge influences their decision to use ergogenic aids in individual sports disciplines. Additionally, Jagim et al (2021) explores the influence of sport nutrition knowledge

on body composition and perceptions of dietary requirements in collegiate athletes [20]. This study can provide insights into how athletes' understanding of dietary requirements based on their nutrition knowledge impacts their utilization of ergogenic aids in individual sports. Delleli et al (2022) investigates the acute effects of caffeine supplementation on physical performance, physiological responses, perceived exertion, and technical-tactical skills in combat sports [42]. Understanding how combat sports athletes utilize caffeine as an ergogenic aid based on their nutrition knowledge can provide insights into the relationship between nutrition literacy and ergogenic aid utilization in this specific sports discipline. Vicente-Salar et al (2022) conducts a systematic review of nutritional ergogenic aids in combat sports [43]. This research can offer insights into the effectiveness of various nutritional ergogenic aids in enhancing performance in sports that require high-intensity efforts, such as combat sports. Additionally, Wong (2020) reviews the effects of honey supplementation on endurance performance in athletes [44]. While not specific to combat sports, this study provides insights into the potential benefits of natural ergogenic aids that may be relevant to combat sports athletes seeking performance enhancement through nutrition.

Moreover, Viribay et al (2020) analyses how energy metabolism-based arginine supplementation affects sports performance [41]. Understanding how athletes in endurance sports utilize arginine as an ergogenic aid based on their nutrition knowledge can offer insights into the connection between nutrition literacy and ergogenic aid utilization in this specific sports discipline. Guest et al (2019) delves into sport nutrigenomics and personalized nutrition for athletic performance [45]. This research underscores the significance of personalized sports nutrition plans, which can be particularly beneficial for endurance athletes looking to enhance their performance through tailored nutritional strategies. Furthermore, Sunuwar et al (2021) investigates the link between nutrition knowledge, practice, supplement use, and nutrient intake with strength performance among Taekwondo players in Nepal [34]. This study suggests that higher nutrition knowledge leads to improved attitudes and practices towards a diet that enhances sports performance, potentially influencing athletic performance in endurance sports. In conclusion, the utilization of ergogenic aids in sports, including legal and illegal substances, is a complex and multifaceted area that is influenced by various factors. Understanding the relationship between an athlete's nutrition knowledge and their utilization of ergogenic aids is crucial for optimizing performance and ensuring athlete well-being. Overall, the correlation between an athlete's nutrition knowledge and their utilization of ergogenic aids underscores the importance of education, personalized nutrition plans, and evidence-based practices in enhancing athletic performance and achieving optimal outcomes in sports.

CONCLUSIONS

The interplay between athletes' nutrition literacy and their use of ergogenic aids represents a critical and complex dimension of sports performance optimization. A comprehensive review of existing literature highlights a clear correlation: athletes with higher levels of nutrition knowledge are more likely to make informed decisions regarding both legal and illicit ergogenic substances. This relationship is mediated by multiple variables, including sport-specific demands, personal beliefs, and accessibility to evidence-based nutritional guidance. These findings underscore the necessity for targeted educational interventions and individualized nutrition strategies to enhance both performance and ethical decision-making in athletic contexts.

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