Nutritional and Hormonal Balance in Athletic Performance and Recovery

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ABSTRACT

Objective: Athletes should eat a whole-food, plant-forward diet rather than unregulated, aggressively marketed "performance-boosting" goods to optimize performance and recovery without accidentally ingesting natural anabolic substances or contaminated supplements.

Methods: This review article employed a modified narrative review and focuses on the nutritional balance of meats, fatty fish, leafy greens, berries, and nuts, which provide essential amino acids, antioxidants, and healthy fats that support recovery and help prevent muscle damage, without the contamination risks associated with supplements.

Results: A balanced diet emphasizes complex carbohydrates, a variety of plant-based protein sources, and moderate amounts of lean protein to support hormonal balance while providing essential nutrients. It also helps prevent excessive intake of naturally occurring steroid compounds and saturated fats commonly found in animal products, particularly high-fat dairy products and processed meats, thereby promoting overall metabolic and reproductive health.

Conclusions: Frequent, nutrient-dense meals consumed throughout the day are more effective for sustaining energy levels, supporting muscle recovery, and promoting tissue repair than relying on dietary supplements. Whole foods provide a balanced array of essential nutrients, whereas excessive use of supplements may contribute to nutrient imbalances, increase the risk of adverse effects, or expose individuals to prohibited substances.

Keywords: Hormonal balance, nutritional balance, athletic performance, athletic recovery, natural steroids, steroids free, balanced diet

1. INTRODUCTION

The quest for optimal athletic performance is inherently linked to better nutrition, with a growing focus on natural, nutrient-dense functional foods. Oils derived from dried fruits, including almonds, walnuts, and pistachios, are gaining prominence in sports nutrition due to their distinctive array of bioactive compounds. These oils are abundant in monounsaturated and polyunsaturated fatty acids (MUFAs and PUFAs), including omega-3, -6, and -9, as well as powerful antioxidants such as vitamin E and different polyphenols. The contemporary comprehension of the impact of dry fruit oils on critical facets of an athlete's health and performance. The functions in energy metabolism, inflammatory regulation, and post-exercise recuperation are crucial. The impact of these oils on essential health metrics for athletes, including cardiovascular function, weight regulation, hormonal balance (particularly testosterone), sexual health, and hepatic homeostasis. Mechanistic findings indicate that the balanced fatty acid composition in these oils maintains cellular membrane integrity, improves endothelial function, acts as a precursor for hormone synthesis, and reduces oxidative stress. Evidence indicates that strategically incorporating dried fruit oils into an athlete's diet may enhance endurance, accelerate recovery, improve body composition, promote cardiovascular health, and optimize endocrine function. The scientific justification for employing dried fruit oils as an advanced nutritional instrument establishes a basis for forthcoming clinical investigations and pragmatic dietary guidelines in sports science (Trivedi et al., 2025).

In sports and active populations, injury prevention techniques often focus on recent injuries or symptoms. The PNR Model, which integrates Physical Profile, Nutrition, and Recovery, emphasizes systemic balance and bodily awareness. Clinical physiotherapy observations and a selected evaluation of musculoskeletal health, exercise science, and recovery. It highlights often-overlooked musculoskeletal stressors for physicians, fitness professionals, and the general public, promoting a more comprehensive injury-prevention approach. In in-person and telehealth settings, the PNR triangle illustrates the dynamic interplay among physical load, biological readiness, and systemic support. Self-awareness, physical intelligence, and subjective monitoring are key to proactive, behavior-centered methods. It also examines how PNR abnormalities affect cardiovascular, immunological, metabolic, and reproductive health (Khunji & Ebrahim, 2025).

The mechanisms of rapid recovery are examined, highlighting the need to mix proteins and carbs in a 3:1 or 4:1 ratio and the critical role of hydration and electrolyte replacement in preventing dehydration. Furthermore, supplements including branched-chain amino acids (BCAAs)—leucine, isoleucine, and valine; essential amino acids (EAAs)—leucine, isoleucine, valine, lysine, methionine, threonine, phenylalanine, tryptophan, and histidine; and creatine are recognized for their contributions to recovery and strength performance. Vitamins C and E, due to their powerful antioxidant properties, safeguard cells against oxidative stress, thereby enhancing recovery. Contemporary scientific research on sports nutrition emphasizes the importance of dietary components such as proteins, carbohydrates, vitamins, and minerals. There is merit in incorporating many elements of sports nutrition and supplementation to optimize post-exercise recovery (Shlykov et al., 2025).

2. LITERATURE REVIEW

2.1 Concept and Classification of Nutrition and Hormonal Balance

Nutrition is the mechanism via which living organisms acquire, assimilate, and employ food and nutrients to facilitate growth, metabolism, repair, and overall well-being. Optimal nutrition is crucial for sustaining physiological processes, averting illness, and enhancing well-being.

Classification of Nutrition
(McLaren & Read, 1972; Kovacevich et al., 1997).

Nutrition can be classified in several ways:

1. Based on the Source of Nutrients
- **Autotrophic Nutrition**: Organisms (like plants) synthesize their own food from inorganic substances using light (photosynthesis) or chemical energy (chemosynthesis).
- **Heterotrophic Nutrition**: Organisms (like animals and humans) obtain food by consuming other organisms.

2. Based on Nutrient Types
- **Macronutrients**: Required in large amounts. Examples: carbohydrates, proteins, fats.
- **Micronutrients**: Required in small amounts. Examples: vitamins, minerals.

3. Based on Diet Types
- **Balanced Diet**: Contains appropriate proportions of carbohydrates, proteins, fats, vitamins, minerals, and water.
- **Unbalanced Diet**: Lacks one or more essential nutrients, leading to deficiencies or health problems.

Concept of Hormonal Balance
(Del Río et al., 2028; Mazza et al., 2024)

Hormonal balance refers to the proper regulation and maintenance of hormones in the body, ensuring that physiological systems function efficiently and harmoniously. Hormones are biochemical messengers synthesized by endocrine glands and conveyed via the bloodstream to specific target organs.

Classification of Hormones
Hormones can be classified based on their structure and function:

1. Based on Chemical Nature
- **Peptide/Protein Hormones**: Made of amino acids (e.g., insulin, growth hormone).
- **Steroid Hormones**: Derived from cholesterol (e.g., cortisol, estrogen, testosterone).
- **Amino Acid Derivatives**: Derived from single amino acids (e.g., adrenaline).

2. Based on the Gland of Origin

- **Pituitary Hormones**: e.g., growth hormone, ACTH.
- **Thyroid Hormones**: e.g., thyroxine.
- **Adrenal Hormones**: e.g., adrenaline, cortisol.
- **Pancreatic Hormones**: e.g., insulin, glucagon.
- **Gonadal Hormones**: e.g., estrogen, testosterone.

Relationship Between Nutrition and Hormonal Balance

- Proper nutrition is essential for the synthesis and regulation of hormones. For example, iodine is necessary for thyroid hormone production, while proteins are required for making peptide hormones.
- Hormonal imbalance can result from poor nutrition (e.g., malnutrition can affect insulin production and lead to diabetes).
- Hormones regulate metabolic processes, appetite, and energy storage, thereby influencing nutritional status.

Nutrition and hormonal balance are interrelated concepts essential for growth, development, and health. Nutrition provides the necessary building blocks for hormones, while hormones regulate how the body uses and stores nutrients.

2.2 Implications of Nutrition and Hormonal Balance for Practices and Health

Avoiding natural steroids aligns with best practices in sports nutrition education, clinical care, and coaching philosophy.

Hormonal Homeostasis

The ability of the human body to maintain a stable internal environment in the face of changing external conditions is known as homeostasis. Osmotic pressure, temperature, and pH are a few of these variables. Although the concept of homeostasis is often discussed in middle and elementary school, the mechanisms underlying it are only briefly discussed. The endocrine system is one of several bodily surveillance mechanisms that maintain homeostasis. The nervous and endocrine systems are both used by the body to maintain internal stability. Although there are many examples of homeostatic regulation in humans and other mammals, the majority follow the same principle. A specific condition stimulates a sensory receptor. An area of control receives a signal from this sensory receptor, interprets it, and determines whether to signal an effector to alter the internal environment. The endocrine system and the chemical indicator molecules known as hormones that are employed in this process are covered in the following section of this paper (Zullo, 2023).

Clinicians recognize that endogenous hormones operate within tightly regulated feedback systems. Steroid-like compounds, even when naturally sourced, may disrupt these systems by artificially amplifying anabolic signaling or suppressing catabolic pathways. Over time, this

interference may impair endocrine balance, contributing to fatigue, mood disturbances, or reduced adaptive capacity. The balance between food intake and energy expenditure determines body weight and composition. At first glance, energy homeostasis, energy metabolism, and energy deposition seem like very straightforward processes, but they are entangled conditions. The various components of this balance are influenced and regulated by factors such as genetic determinants, sex hormones, environmental influences, nutritional traits, hedonic behavior, activity level, metabolic efficiency, and social and economic factors. In this sense, it has been proposed that the pandemic increase in fat gain may also be caused by several underappreciated or subtle factors. One of these could be the surrounding temperature and the thermal processes that sustain homeothermy, as will be covered below (Fernandez-Pena et al., 2023).

Recovery Integrity and Training Decisions

For coaches, recovery is a key determinant of sustainable performance. Artificially enhancing anabolic processes may mask fatigue or tissue stress, encouraging premature training progression. A nutrition-based recovery model respects physiological feedback and supports appropriate training load management. Even though research indicates that peer training can be a useful strategy for supporting employees, organizations must ensure the integrity of the training system and prepare peer trainers for this crucial role. This problem has been the subject of a few studies. For instance, the impact of a 60-minute group training on trainer integrity, that is, how well peer trainers apply behavioral skills training [BST] was assessed. To teach peer trainers how to teach colleagues two target skills (i.e., embedded teaching, conducting a preference assessment), the group training integrated BST components: instructions, modeling, practice, and feedback. Erath et al. (2020) reported improvements in trainer integrity during simulated role-plays using a multiple-probe design. While successful as a first step toward enhancing trainer integrity, it failed to assess peer trainers' integrity in the context of actual service-delivery difficulties. Furthermore, only a few of the skills trainers are expected to teach to newly hired employees were covered in the training provided to peer trainers. By assessing training integrity within a peer training system that also included continuing support, we aimed to address the shortcomings of both studies and expand on their preliminary findings (Blackman et al., 2022).

2.3 Safety, Regulation, and Ethical Sport

From clinical and educational perspectives, supplement contamination and mislabeling pose significant risks. Athletes subject to anti-doping regulations may inadvertently violate rules, while recreational athletes may expose themselves to unnecessary health risks. Steroid-free nutrition supports ethical participation in sport and transparent athlete development.

Sports and physical exercise are essential for improving mental and physical well-being, promoting social cohesiveness, and building cultural capital and national identity. However, there are significant risks associated with these advantages. Athletes may be encouraged to take risks by the competitive pressure inherent in elite sports, frequently at the expense of safety precautions and moral principles. The importance of safety management in sports has increased

with the rapid commercialization and globalization of the sports industry. Modern sporting events present complicated safety issues that require effective management, particularly those that draw large crowds. This "winning at all costs" mentality puts athletes' long-term health at risk and raises the likelihood of injuries, especially in settings where safety rules are either disregarded or poorly enforced. Beyond athletes, spectators, coaches, and facility employees are all impacted by unsafe sporting environments, which can erode public confidence in sports organizations (Bryce & Dowling, 2024).

2.4. Principles of Nutrition Balance for Steroid-Free Performance

Balanced nutrition provides the biochemical foundation for performance and recovery. For students, this section reinforces core nutritional principles. For clinicians and coaches, it offers a framework for practical application. Nutrition balance involves adequate total energy intake, appropriate macronutrient distribution, micronutrient sufficiency, and strategic nutrient timing. Emphasis on whole foods, dietary diversity, and individualized planning reduces dependence on pharmacologically active supplements.

2.5. Macronutrient Strategies: Applied and Educational Insights

2.5.1 Protein

Protein supports muscle repair, immune function, and enzymatic activity. Educational guidelines typically recommend 1.6–2.2 g/kg/day for athletes, with the amount adjusted based on training load and energy availability. Clinicians should consider injury status, risk of energy deficiency, and renal health when individualizing intake. For coaches, practical strategies include distributing protein evenly across meals and prioritizing whole-food sources such as lean meats, fish, eggs, dairy, legumes, and soy-based products.

Protein sufficiency is linked to several health outcomes, including immune defenses, bone health, muscle mass and strength, body weight, body composition, and most, if not all, physiological processes. Growth, maintenance, bodily functions, health, and survival all depend on a sufficient protein intake. The ability of protein to supply sufficient nitrogen and all nine IAAs under various physiological conditions in humans is linked to protein quality. The amount of protein obtained from food and diet, the composition and concentration of AAs, and the bioavailability of nitrogen and AAs derived from protein all affect the nutritional value of proteins. Because there are variations among the various food sources, protein quality is important. Furthermore, protein quality may be impacted by certain food processing and storage methods (Vissamsetti et al., 2023). Food protein quality is influenced by protein density, or concentration, the quantity of protein per unit of food (Pinckaers et al., 2021). The most popular method for determining the amount of protein in food is still to measure the nitrogen content using the Kjeldahl or Dumas methods and the nitrogen-to-protein conversion factor. For a combination of protein sources, the default conversion factor is 6.25, which translates to a 16% nitrogen content. For the main protein sources in the diet, specific protein conversion factors range from 5.7 (17.5% nitrogen) to

6.4 (15.6% nitrogen). Animal protein sources are rich in protein, with a protein content of 30–70% (dry weight, dw), reflecting the protein concentration of various food protein sources. The highest protein concentrations among vegetables are found in pulses, which range from 20–25% (dw) in most raw beans and peas to 35–38% in soybeans and lupines. The protein content of cereal seeds is 15–20% (dw). The protein content of most nuts and edible seeds ranges from 8 to 18% (dw). According to Calvez et al. (2024), many oilseeds contain 12–20% protein (dw), and the cake left over after oil extraction may contain 30–40% protein.

2.5.2 Carbohydrates

Carbohydrates are essential for maintaining training intensity and facilitating recovery. Students should understand their role in glycogen replenishment and fatigue resistance. Clinicians may tailor carbohydrate intake based on metabolic health and training demands, while coaches should emphasize the timing of carbohydrate intake around training sessions. There are two primary categories of carbohydrates: simple and complex. One or two sugar units make up simple carbohydrates, while numerous sugar units make up complex carbohydrates. Three types of carbohydrates are identified: monosaccharides (glucose, fructose, and galactose), disaccharides (maltose, sucrose, and lactose), and complex carbohydrates (starch, glycogen, and fiber). It is thought that during the evolution of hominins into modern humans, carbohydrates from plants and meat were essential and complementary dietary components. Therefore, starch from plant foods was necessary to meet the increased aerobic capacity and metabolic demands of a developing brain, which may have been a significant evolutionary advantage for omnivorous hominins during the middle and late Pleistocene. Furthermore, it has been suggested that the transition from a high-volume low-energy diet to a low-volume high-energy diet caused a number of significant changes in hominin morphology linked to the emergence of H. erectus, including a significant increase in body weight and height, a decrease in tooth size, and an increase in brain size. The salivary amylase gene (AMY1), which initiates starch breakdown in the mouth and is linked to blood glucose levels and carbohydrate digestion, also varied in copy number. Foods high in carbohydrates, particularly refined sugars, have seen an exponential rise in consumption due to their energy-boosting effects that combat fatigue and enhance well-being. Research has focused on determining how these foods, and carbohydrates (CHO) in general, might support optimal cognitive function and emotional well-being, given that sugar is their primary ingredient (Clemente-Suarez, 2022).

2.5.3 Dietary Fats

Dietary fats support energy balance, cell membrane integrity, and endogenous hormone production. Avoiding extreme fat restriction is particularly important for maintaining hormonal stability in steroid-free athletes. Sources such as nuts, seeds, olive oil, and fatty fish should be emphasized. Based on the quantity of chemical double bonds, dietary fats are classified as monounsaturated, polyunsaturated, or saturated. Trans fats are a fourth category that arises from the partial hydrogenation of vegetable oils, produced either naturally in beef, lamb, and dairy products or industrially (e.g., margarines) (Bajzelj et al., 2021). Fish, a variety of plant-based

oils, nuts, and seeds are the main sources of monounsaturated fats. Animal products and palm oil are the main sources of saturated fats (Cena et al., 2020). However, it is rarely possible to use such general terms precisely in practice. Along with numerous other fatty and non-fatty acids, most fats are complex chemical mixtures of all major saturated fatty acids in varying amounts. Each of these fat types has a unique effect on health, which can be either positive or negative, as with polyunsaturated essential fatty acids. The intricate relationships between hundreds of thousands of food ingredients, their interactions with one another, and their interactions with various aspects of human health are still being studied (Aleta et al., 2022). Traditionally, the effects of dietary fats on serum cholesterol have been used to estimate their effects on cardiovascular disease risk; however, there is a shift in perspective regarding the health implications of these measures. The ideal intake ratios of omega-3, -6, and -9 fatty acids are also a topic of ongoing discussion (Alagawany et al., 2021).

2.5.6. Micronutrients: Clinical Relevance and Practical Monitoring

Micronutrient adequacy is critical for performance and recovery. Clinicians should assess the risk of nutrient deficiencies while students learn the mechanistic roles of key nutrients.
Key micronutrients include magnesium (muscle and sleep regulation), zinc (immune and protein synthesis), iron (oxygen transport), vitamin D (musculoskeletal health), and B-complex vitamins (energy metabolism). Coaches should encourage dietary variety and refer athletes for assessment when symptoms of deficiency are suspected. Nutrients necessary for survival and good health that are present in trace amounts are known as micronutrients. They fall into two categories: fat-soluble and water-soluble trace minerals and vitamins. Micronutrients typically do not include microminerals, such as calcium and sodium. In the past, the significance of micronutrients was acknowledged because relatively severe deficiencies led to pronounced clinical symptoms; however, in most cases, it took centuries to identify the specific nutrients. Because it applies to long-term daily use of supplements and fortified foods, the tolerable upper intake level is particularly helpful for micronutrients. When the EAR or RDA cannot be ascertained, a fourth value—adequate intake—is employed. This is a suboptimal situation because the EAR is used to determine the type and level of micronutrient interventions required and to assess the percentage of individuals within population groups who have inadequate intake. For most nutrients, EAR and upper intake values are provided by both NASEM and EFSA; however, a significant portion of EARs are missing because average intakes were calculated instead. The prevalence of insufficient micronutrient intake was recently estimated nationally and subnationally using a "harmonized" set of nutrient reference values, primarily a combination of values from NASEM and EFSA reports (Allen, 2025).

2.5.7. Evidence-Based Supplementation Without Hormonal Manipulation

Supplementation should be conservative, purposeful, and evidence-based.

- **Creatine monohydrate**: Supported by extensive research; improves strength and power without hormonal disruption.

- **Protein supplements**: Useful for meeting intake targets when food access is limited.
- **Omega-3 fatty acids**: Support inflammation control and cardiovascular health.
- **Electrolytes**: Assist hydration during prolonged or high-heat training.

Clinicians should monitor supplement use, while coaches should reinforce that supplements complement, rather than replace, nutrition.

2.5.8. Nutrient Timing and Recovery: Coaching and Clinical Application

Post-exercise nutrition combining carbohydrates and protein accelerates glycogen restoration and muscle repair. Regular meal patterns stabilize energy availability and reduce reliance on stimulant or anabolic products. Hydration strategies should be individualized based on sweat rate and environmental conditions. Nutrition provides vital components for tissue repair, energy replenishment, and fluid balance, all of which are critical for post-exercise recovery. Consuming protein is especially important because it provides the amino acids required to regenerate and repair muscle fibers that sustain microtears during exercise, a process critical for muscle growth and adaptation (Dhiman et al., 2023). A healthy protein diet minimizes soreness and lowers the risk of injuries such as sprains and strains, especially in high-impact sports, by supporting muscle fiber repair and overall muscle stability (Kaspy et al., 2023). To prepare muscles for future performance demands, glycogen, which is depleted during intense activity, must be replenished by consuming carbohydrates. Depending on one's level of athletic ability, dietary supplements may or may not be necessary for recovery. For elite athletes with demanding training schedules, supplementation is often necessary to meet their increased nutritional needs, promote rapid recovery, and support peak performance. Supplementation is important for maintaining a competitive edge because their hectic schedules may not allow them to meet these needs solely through diet. On the other hand, amateur athletes who engage in less strenuous training may often meet their nutritional needs without supplements by eating a balanced diet. Understanding these variations enables the customization of nutritional recommendations to meet the unique needs of athletes at different levels (Wang et al., 2024).

2.5.9. Integrating Nutrition, Training, and Lifestyle

Sleep quality, stress management, and training periodization interact with nutrition to shape performance outcomes. Coaches play a central role in integrating these factors, while clinicians address sleep disorders, overtraining symptoms, and injury recovery. Students should recognize the interdisciplinary nature of athlete support systems. Over the past ten years, health systems and payers have moved toward value-based strategies and the creation of accountable care organizations. As a result, healthcare providers must improve patient outcomes while reducing costs by implementing lifestyle and preventative interventions that address social needs. Social needs screening has become widely used, and investments in related resources and care management have increased because the Centers for Medicare and Medicaid Services and the Joint Commission require hospital quality measures related to social drivers of health and health equity standards. While better screening is an important starting point, leaders must have solid

nutrition education to develop and direct sustainable solutions to social problems like food insecurity (Albin et al., 2024).

2.5.10. Ethical, Educational, and Long-Term Health Considerations

A steroid-free nutrition strategy supports ethical participation in sport, long-term health, and professional accountability. For educators, it reinforces foundational scientific principles. For clinicians and coaches, it promotes athlete welfare and sustainable performance trajectories. A growing body of research indicates that repeated episodes of extreme exercise (like UER) may have detrimental effects on long-term human health, even though regular physical activity is known to provide significant health benefits and extend life. Frequent aerobic exercise lowers the risk of cardiovascular disease and all-cause mortality, among other health benefits. In several endurance sports, including running, longitudinal studies of former world-class or recreational athletes have reported positive effects. Though the importance and ramifications of such changes are still up for debate, it is also known that long-term endurance exercise training has a significant structural and functional impact on the heart, including morphological and histological cardiac remodeling, arrhythmias, sinus node dysfunction, and elevated coronary artery calcium (CAC) scores (Scheer et al., 2022).

2.5.11. Key Learning Points, Clinical Insights, and Coaching Notes

Key Learning Points (For Students)

- "Natural steroids" are not nutritionally essential compounds but biologically active agents often marketed without robust long-term safety data.
- Athletic performance and recovery can be fully supported through balanced macronutrition, micronutrient sufficiency, and appropriate energy availability.
- Proteins support tissue repair and adaptation, carbohydrates fuel training intensity and recovery, and fats maintain metabolic and hormonal stability.
- Evidence-based supplementation enhances physiological efficiency without disrupting endocrine regulation.
- Sustainable athletic development depends on nutrition–training–recovery integration rather than pharmacological shortcuts.

Clinical Insights (For Clinicians)

- Assess athletes for low energy availability, micronutrient deficiencies, sleep disturbance, and excessive supplement use before considering ergogenic aids.
- Avoidance of steroid-like supplements reduces risks of hormonal dysregulation, supplement contamination, and adverse drug–nutrient interactions.
- Creatine, protein supplementation, omega-3 fatty acids, and electrolytes demonstrate favorable safety profiles when used appropriately.
- Regular dietary assessment and biochemical monitoring (where indicated) are preferable to indiscriminate supplementation.

Coaching Notes (For Coaches and Trainers)

- Reinforce that recovery quality—not supplement intensity—drives long-term performance gains.
- Encourage athletes to prioritize meals, hydration, and sleep before seeking performance enhancers.
- Monitor signs of under-recovery such as persistent fatigue, declining performance, or mood changes.
- Foster a team culture that values clean sport, transparency, and nutrition literacy.

Intervention Strategy:

- Normalize total energy intake with emphasis on protein adequacy.
- Balance carbohydrate intake to support training volume.
- Introduce creatine monohydrate as a non-hormonal ergogenic aid.
- Implement structured rest and sleep hygiene practices.

Outcome: Improved recovery, stable strength progression, and enhanced training tolerance.

2.5.12. Curriculum Alignment: Sports Nutrition, Pharmacy, and Clinical Education

This review aligns with undergraduate and postgraduate curricula in sports nutrition, pharmacy, and clinical sciences by integrating:

- Nutrient metabolism and physiological adaptation principles
- Supplement safety, regulation, and ethical considerations
- Clinical assessment of dietary adequacy and recovery status
- Applied case-based learning for real-world decision-making

The steroid-free framework reinforces foundational learning outcomes while preparing students and professionals for responsible roles in athlete support.

2.6 Key Terms and Definitions

2.6.1 Nutritional Balance

Nutritional balance is a balanced diet that includes various foods in specific ratios and proportions to adequately meet requirements for calories, protein, vitamins, minerals, and other essential nutrients. Small quantities are retained for short-term nutrient restoration. Nutritional balance refers to the intake of appropriate quantities and ratios of nutrients essential for good bodily function. It entails obtaining sufficient amounts of carbohydrates, protein, fat, vitamins, minerals, water, and fiber in one's diet to support health, growth, and physiological functioning.

2.6.2 Athletic Recovery

Athletic recovery refers to the strategies and practices athletes use to restore their physical and mental well-being after training, competition, or intense physical activity. Efficient recovery is crucial for improving performance, averting injuries, and fostering overall health.

2.6.3 Athletic Performance

Athletic performance is an athlete's ability to perform physical activities efficiently, including strength, speed, endurance, and skill, all of which are essential for success in sports and competitions.

2.6.4 Hormonal Balance (Equilibrium)

The ideal levels and effective functioning of hormones throughout the body. Hormones are biochemical messengers synthesized by endocrine glands, including the pituitary, thyroid, adrenal glands, pancreas, and gonads. They govern a broad spectrum of physiological functions, encompassing growth, metabolism, stress response, reproduction, and mood regulation.

2.6.5 Balanced Diet

A balanced diet supplies all important nutrients: carbohydrates, proteins, fats, vitamins, minerals, fiber, and water—in appropriate quantities to sustain health, facilitate growth and development, and avert disease. It guarantees that your body receives all the necessary elements for proper functioning.

2.6.6 Natural Steroids and Their Relevance to Sport Athletes

Natural steroids are chemicals synthesized by the body (endogenous) or present in specific foods and plants that exhibit steroid-like properties. The primary natural steroids in the body are hormones such as Testosterone (an androgen), which promotes muscle hypertrophy, enhances strength, and accelerates recovery. Cortisol (a glucocorticoid) facilitates the body's response to stress and regulates metabolism. Estrogen and Progesterone: Integral to reproductive health and physiological development. These hormones are crucial for optimal physiological processes and sports performance.

3. METHODOLOGY

This article employed a modified narrative review. A narrative review is a thorough, author-driven synopsis and analysis of the body of research on a particular subject. In contrast to rigorous systematic reviews, it employs a flexible methodology that organizes evidence thematically rather than by a specific protocol, enabling the author to present a coherent, instructive narrative on the topic (Siripipatthanakul & Auttawechasakoon, 2026; Siripipatthanakul et al., 2026). This paper is a narrative review on related topics, using the keywords: hormonal balance, nutritional balance, athletic performance, athletic recovery, natural steroids, steroid-free, and balanced diet. Peer-reviewed scholarly papers that have been published in English were selected.

4. RESULTS & DISCUSSIONS

4.1 Pragmatic suggestions for enhancing food literacy among adolescent athletes encompass

Comprehensive sports nutrition education initiatives: Incorporating extensive sports nutrition instruction inside educational institutions and/or athletic organizations, emphasizing macronutrients, hydration, meal preparation, and meal timing. This education must encompass the dangers and indicators of eating disorders while emphasizing the significance of mental health in conjunction with physical health and performance.

Parental/guardian engagement: Promoting active participation of parents/guardians in cultivating good dietary practices by incorporating teenagers in meal planning, culinary preparation, and grocery procurement. This fosters the development of practical skills while promoting good perceptions of food and body image within the home environment. Advocating for realistic and healthy body standards: Cultivating a society that prioritizes health over aesthetics. Parents, guardians, coaches, and peers exemplify body-positive attitudes that enable athletes to focus on achieving their personal best rather than adhering to unattainable body standards. Policy and advocacy: Promoting policies that enhance access to nutritious food options in educational institutions and sports organizations, while fostering the establishment of nutrition and mental health education programs to avert disordered eating. Facilitating access to healthcare professionals: Guaranteeing that youth athletes can engage with multidisciplinary teams comprising physicians, psychologists, and nutritionists for early intervention and continuous support. This is particularly crucial for athletes exhibiting symptoms of eating disorders or those susceptible to body image issues.

4.2 Audience-Adapted: Students, Clinicians, and Coaches

Athletic performance and recovery are governed by an intricate interaction of training stimuli, nutritional intake, recovery practices, and individual physiology. For students of sports science and nutrition, understanding these interactions provides the conceptual foundation for evidence-based practice. For clinicians and coaches, this knowledge translates into informed decision-making that supports performance while safeguarding athlete health. In recent years, the growing availability of so-called "natural steroids" and steroid-like supplements has complicated the sports nutrition landscape. These products are often marketed as safe, legal, and plant-derived alternatives to anabolic steroids, appealing to athletes seeking rapid gains in strength, endurance, and recovery. However, from educational, clinical, and coaching perspectives, reliance on such compounds raises concerns about hormonal balance, safety, regulatory compliance, and long-term adaptation. This chapter is written for a mixed professional and academic audience—students, clinicians, and coaches—and emphasizes a nutrition-centered, steroid-free framework for athletic performance and recovery. The chapter integrates foundational concepts for learners, clinical considerations for health professionals, and practical guidance for those directly responsible for athlete development. By focusing on balanced macro-nutrition, micronutrient adequacy, recovery-oriented eating patterns, and non-hormonal supplementation, this approach supports both performance excellence and long-term athlete well-being.

5. CONCLUSIONS

This chapter presents a comprehensive, steroid-free nutrition framework for athletic performance and recovery, suitable for academic and professional audiences alike. By emphasizing balanced macro-nutrition, micronutrient sufficiency, structured recovery practices, and selective non-hormonal supplementation, the chapter supports sustainable performance without compromising health or ethical standards. For students, the chapter reinforces foundational concepts in nutrient metabolism and exercise adaptation. For clinicians, it provides a safety-focused, assessment-driven perspective on supplement use and recovery support. For coaches, it translates scientific principles into practical strategies that enhance training outcomes and athlete well-being. Collectively, this approach promotes long-term athletic development grounded in physiology rather than pharmacological shortcuts. This chapter provides a flexible, steroid-free nutrition framework that can be effectively adapted for use in pharmacy, sports science, and clinical nutrition textbooks. By tailoring emphasis to pharmacological safety, physiological adaptation, or clinical care, educators and practitioners can apply a unified evidence-based approach while meeting discipline-specific learning objectives. Avoidance of natural steroids reinforces ethical practice, long-term health, and sustainable athletic performance across all professional domains.

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