
Module 3: Risks of Supplement Use

Learning Objectives of the Module

After the successful completion of this module, you will be able to:

Remember & Understand

- Describe the historical development of dietary supplements and the factors that contributed to their widespread use in sport and society.
- Differentiate between the major categories of dietary supplements (sports foods, medical-, ergogenic- and mixed/emerging-evidence supplements) and their intended purposes.
- Explain the major health risks of supplement use and the concept of inadvertent doping under anti-doping regulations.

Apply & Analyze

- Classify commonly used supplements according to their intended purpose and the strength of scientific evidence supporting their use.
- Analyze the potential health and anti-doping risks associated with supplement use in different athletic scenarios.
- Compare food-first nutrition strategies with supplement use to determine the most appropriate approach for supporting athlete health and performance.

Evaluate & Create

- Evaluate the benefits and risks of dietary supplement use using current scientific evidence and anti-doping principles.
- Develop an evidence-based decision-making process for selecting supplements while minimizing health and inadvertent doping risks.
- Design practical recommendations for athletes, coaches, or parents that promote safe, ethical, and evidence-based supplement use.

1. History of Dietary Supplements

Nutritional supplements did not appear suddenly in the late 20th century; they emerged from a long historical trajectory linking ancient tonics, the scientific discovery of vitamins, industrial food processing, global capitalism, and transformations in health systems—especially visible in post-communist societies. Across this history, we see a recurring pattern: people seek to correct perceived deficiencies, enhance vitality, and gain control over health by concentrating and consuming particular substances, moving gradually from herbs and organ extracts to standardized pills, powders, and sports drinks.

1.1. Ancient and traditional origins

Long before modern pharmacology, many civilizations used concentrated plant, mineral, and animal products for health, strength, and longevity, functioning as early “supplements” even if the concept of vitamins did not

yet exist. In ancient Egypt, garlic, onions, and herbs were given to workers and soldiers to increase endurance and resistance to disease, while medical papyri recorded complex recipes mixing botanicals, resins, and animal products in dosed preparations. Ancient Greek medicine, particularly in the Hippocratic tradition, emphasized “food as medicine,” treating specific foods and wine-herb mixtures as targeted remedies to restore humoral balance; athletes used rich diets and special tonics to improve performance. In Traditional Chinese Medicine, qi-tonifying formulas containing ginseng, astragalus, and medicinal mushrooms were taken as long-term tonics for energy and longevity, anticipating modern “adaptogens” and immune supplements. Ayurveda in South Asia developed rasayana therapies—rejuvenating preparations such as chyawanprash and botanicals like ashwagandha—to promote ojas, resilience, and long life, conceptually similar to modern daily tonics and anti-aging products.

These systems shared several features that prefigure the supplement concept: the idea of “extra” foods with special potency, personalization based on constitution or imbalance, and long-term preventive use to maintain strength rather than only treat acute disease. What they lacked was the biochemical language of “vitamins,” “minerals,” or “antioxidants”; instead, they spoke of humors, qi, or doshas, embedding supplementation in religious and cosmological frameworks that still echo in contemporary marketing of “natural” products.

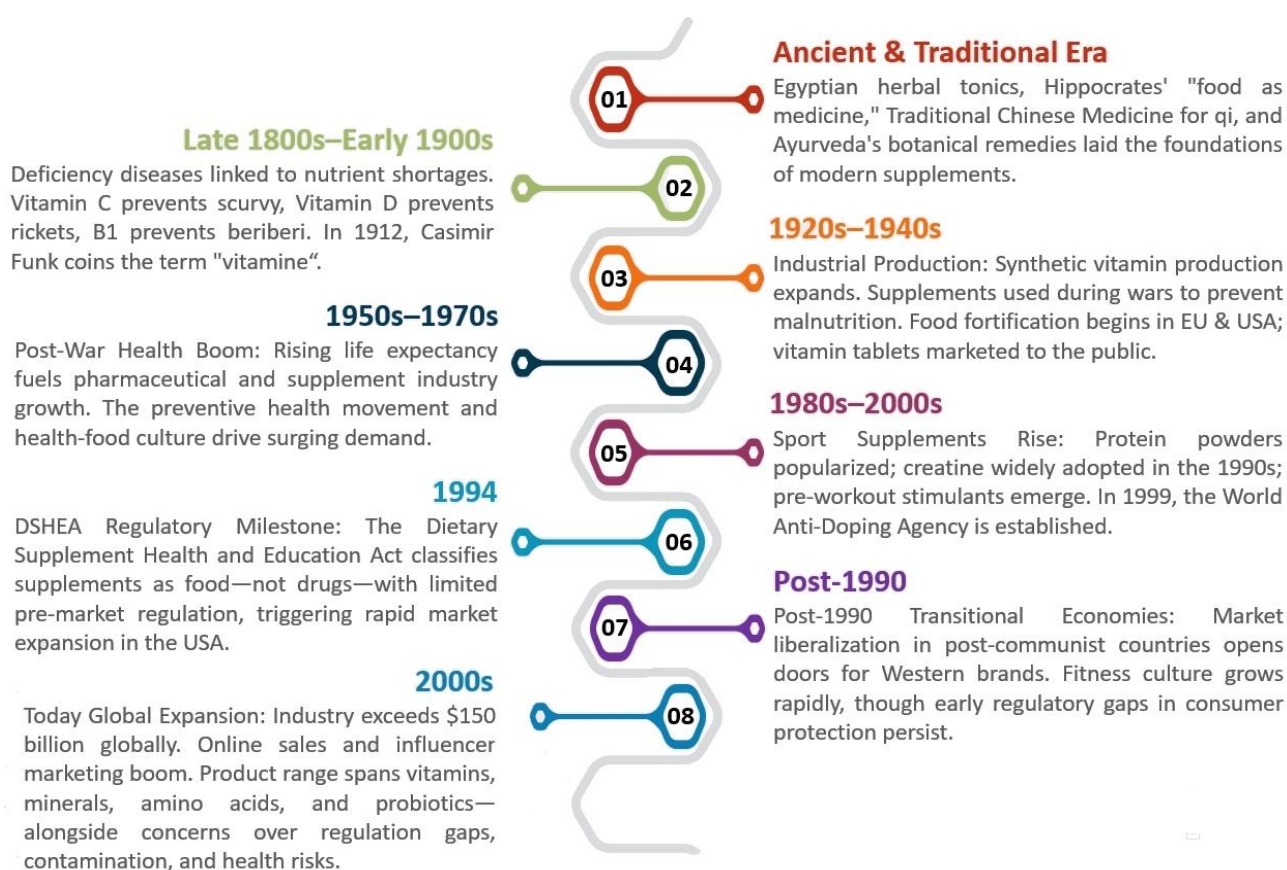


Image 1: History of Dietary Supplements

1.2. 19th century: discovery of vitamins

The 19th century brought scientific tools that gradually translated these traditional practices into the language of nutrients, particularly through the study of deficiency diseases. James Lind’s 1747 experiment showing that

citrus fruits prevented scurvy among sailors was an early clue that certain foods contained specific “anti-scorbutic” factors, even if the concept “vitamin” did not yet exist. In the late 19th and early 20th centuries, researchers studying beriberi, pellagra, rickets, and other conditions realized that these were not infections but diet-related diseases, pointing to “accessory factors” in food beyond proteins, fats, carbohydrates, and minerals.

Frederick Hopkins showed around 1906 that animals could not live on purified macronutrients alone and needed additional, unidentified substances, which he called “accessory food factors.” In 1912, Casimir Funk coined the term “vitamine” after working on the anti-beriberi factor (thiamine), suggesting that these were “vital amines” necessary for life. Over the following decades, scientists identified and isolated vitamins A, B1, C, D, E, and others, with discovery dates stretching roughly from the early 1900s to mid-20th century. This period reframed health in biochemical terms: deficiency was no longer an abstract imbalance but a lack of specific molecules that could, in principle, be isolated, purified, and delivered in concentrated form.

The discovery of vitamins thus laid the conceptual foundation for supplements as discrete, measurable entities that could be added to diets—bridging earlier folk practices and modern pharmaceutical approaches. It also created a new logic of health: if disease is caused by missing factors, then pills or fortified foods might prevent disease even in otherwise poor diets, a belief that will later underpin mass supplementation campaigns and commercial multivitamins.

1.3. Early–mid 20th century: industrial production

With vitamins identified chemically, the early–mid 20th century saw the rise of industrial production and fortification programs. Chemists learned to synthesize or concentrate vitamins at scale; vitamin A, several B vitamins, C, and D were gradually produced as bulk ingredients by pharmaceutical and chemical companies. At the same time, governments in Europe and North America began to fortify staple foods—iodized salt to prevent goiter, enriched flour and bread to reduce anemia and neural tube defects, vitamin D–fortified milk to combat rickets.

By the 1940s, one-a-day multivitamin tablets appeared on the market, and brands such as Geritol (an iron and B-vitamin tonic introduced around 1950) blurred the line between medicine, tonic, and everyday product. Industrial processing created both the problem and the solution: highly milled, shelf-stable foods often lost natural micronutrients, but companies could now add synthetic vitamins back in, positioning this as scientific progress. The Second World War accelerated this trend, as nutrition became a strategic issue: armies needed healthy soldiers, and national nutrition conferences promoted fortified foods and supplements for the war effort.

Regulatory structures began to catch up. In the United States, the 1906 Pure Food and Drugs Act and later the 1938 Food, Drug, and Cosmetic Act aimed to control misbranding and unsafe products, laying a framework that would eventually cover vitamin preparations, though not as strictly as pharmaceuticals. By mid-century, vitamins and tonics were part of everyday consumer culture, endorsed by doctors and advertised directly to the public, particularly for children, workers, and “tired” adults.

1.4. Post–World War II expansion

After World War II, rising incomes, urbanization, and the growth of consumer capitalism created fertile ground for an expanding supplement market. In the United States and Western Europe, multivitamin use increased steadily from the 1950s onward, with supplements marketed for energy, growth, and “insurance” against poor diets. The figure of the modern housewife buying vitamins for her family became a recurring advertising motif, linking supplementation with responsibility, care, and modernity.

Simultaneously, food technology innovations produced new forms—instant drinks, powdered tonics, chewable tablets—that made supplementation easy and attractive. Industrially produced cod liver oil, iron syrups, and vitamin tonics were given to children in schools or homes to support growth and prevent rickets or anemia, often with state endorsement. In many countries, this era normalized the idea that “good parenting” involved giving children extra vitamins, even when clinical deficiency was rare.

From a scientific perspective, nutrition research expanded beyond deficiency diseases to investigate optimal intakes, recommended dietary allowances (RDAs), and the role of vitamins in chronic disease prevention. However, this period also saw early tensions: some experts warned against excessive supplementation, while industry emphasized safety and potential benefits even at higher doses, foreshadowing later debates over megavitamins and antioxidant pills.

1.5. 1970s–1990s: commercial boom and regulation

From the 1970s to the 1990s, dietary supplements underwent a commercial boom, especially in the United States, amid broader cultural shifts toward self-care, natural health, and deregulated markets. Surveys show a marked increase in vitamin and mineral supplement use from the 1970s onward, with multivitamins becoming a standard item in many households. This era also saw diversification: beyond basic vitamins, consumers encountered botanicals (ginkgo, echinacea, ginseng), amino acids, fish oil, and “natural” tonics, often marketed through health food stores and emerging wellness subcultures.

Regulation became a contested political arena. In the U.S., the Food and Drug Administration attempted to regulate high-dose vitamins and new supplement categories more strictly, provoking backlash from industry and consumer groups who framed supplements as a matter of freedom and personal choice. The conflict culminated in the 1994 Dietary Supplement Health and Education Act (DSHEA), which defined supplements as a category of food rather than drugs, limited pre-market approval requirements, and allowed broad marketing as long as no explicit disease claims were made. DSHEA is often seen as a turning point that enabled rapid growth of the supplement industry while leaving safety oversight relatively weak compared with pharmaceuticals.

Globally, parallel developments occurred, though regulatory regimes varied. In Western Europe and parts of Asia, supplements expanded under diverse combinations of health-food cultures, pharmaceutical traditions, and national rules; meanwhile, international trade and marketing began to create a more globalized supplement supply chain. The result was an increasingly complex market in which pharmaceuticals, foods, and supplements were difficult for consumers to clearly distinguish.

1.6. Rise of sport supplements (1980s–2000s)

Within this broader boom, supplements targeting athletes and fitness enthusiasts emerged as a distinct sub-industry. A landmark often cited is the commercialization of specialized protein products and sports drinks: bodybuilding protein powders were advertised as early as the 1950s, and products like Gatorade in 1965 inaugurated the modern sports drink category. However, it was in the 1980s and 1990s that sport supplements—whey protein, creatine, amino acids, “fat burners,” pre-workouts—became widely visible.

Several factors drove this rise. First, the fitness boom and bodybuilding culture, represented by figures like Arnold Schwarzenegger, made muscular physiques and gym training aspirational, creating demand for nutrients supposedly necessary for gains. Second, sports science research on creatine, caffeine, and carbohydrate loading provided credible evidence for certain ergogenic aids, which companies rapidly translated into products. Third, professionalization of sport and commercialization of athletic performance pushed athletes to seek legal performance advantages, blurring boundaries between nutrition, supplementation, and doping.

At the same time, risks of contamination and unregulated ingredients became apparent. Studies found that a significant fraction of over-the-counter sport supplements contained undeclared anabolic steroids or stimulants, leading to cases of inadvertent doping and health harms. Anti-doping organizations responded with education campaigns and third-party certification schemes (e.g., Informed Sport, NSF Certified for Sport), reflecting a new regulatory and ethical landscape in which sport supplements are simultaneously normalized and suspect.

1.7. 21st century: global industry and controversy

By the early 21st century, dietary supplements had become a multi-billion-dollar global industry, encompassing vitamins, minerals, herbs, probiotics, weight-loss products, “nootropics,” and sports nutrition. The market is highly internationalized: ingredients are sourced from multiple countries, products are manufactured and private-labeled for different brands, and e-commerce platforms allow direct-to-consumer sales across borders. In many high-income countries, a substantial proportion of adults report regular supplement use, often with multiple products.

Controversy accompanies this growth on several fronts. First, evidence for many popular supplements (e.g., antioxidant megadoses for cardiovascular prevention) is weak or mixed, with large trials sometimes showing no benefit or even harm, while marketing continues to suggest broad protective effects. Second, regulatory frameworks like DSHEA place the burden of proof largely on authorities after products reach the market, leading to recurrent scandals involving adulteration, mislabeling, and unapproved substances. Third, sociologists and public health scholars argue that supplement culture individualizes responsibility for health and obscures structural determinants of disease, while reinforcing commercial logics of self-optimization.

At the same time, nutrigenomics, personalized nutrition, and longevity science have opened new frontiers for high-end supplementation, from personalized micronutrient packs to anti-aging cocktails aimed at mitochondrial function, senolytics, or the microbiome. The supplement thus participates in a broader “bio-economy” where bodies and health are sites of investment, experimentation, and risk.

1.8. Supplements in post-communist and transitional societies

The trajectory of supplements in post-communist Eastern Europe and other transitional societies adds another layer, where market liberalization, healthcare reforms, and cultural change intersect. Under state-socialist regimes, access to pharmaceuticals and special nutrients was tightly controlled, and shortages were common, but there was also an official ideology of universal, free healthcare and centralized control over drugs and advertising. Informal practices existed—home remedies, “under-the-counter” imports, and doctor-mediated access to Western vitamins—but the public supplement market was limited.

After 1989, the collapse of socialist systems brought rapid marketization, privatization, and exposure to Western consumer cultures. Trade liberalization and foreign direct investment expanded the availability of Western medicines, vitamins, and later sports supplements, often without equally rapid development of regulatory capacity. At the same time, healthcare reforms introduced elements of insurance, private provision, and user fees, creating perceptions of declining security and rising individual responsibility for managing health.

In this context, supplements came to symbolize both new freedoms and new anxieties. On one hand, the ability to purchase imported vitamins, herbal preparations, and protein powders signaled modernity, integration into global markets, and personal choice. On the other hand, marketing exploited fears about deteriorating public healthcare, environmental pollution, and stress, positioning supplements as necessary compensations for systemic failures. Trade and dietary studies in Eastern Europe and Central Asia show shifts in food systems and dietary diversity linked to trade reforms, which likely interact with supplement consumption as both substitute and complement to changing diets.

Generational patterns also matter. Younger cohorts in post-communist countries tend to be more supportive of market principles, private consumption, and individual responsibility, making them more receptive to lifestyle, fitness, and supplement cultures that mirror Western trends. For athletes in these societies, sport supplements intertwine with broader transformations in sport structures, doping controls, and commercial sponsorship, often in conditions of regulatory ambiguity and uneven enforcement.

Thus, in transitional societies the supplement is not merely a neutral health technology, but a sociological artifact of systemic change: it reflects the shift from state-guaranteed healthcare to individualized self-care, from scarcity to abundance, and from socialist egalitarian promises to stratified access mediated by income, marketing, and global supply chains.

1.9. Understanding supplements historically and sociologically

Across these phases—from ancient tonics to post-communist markets—supplements have continually redefined the relationship between food, medicine, and the body. The modern capsule or sports drink carries traces of Egyptian garlic tonics, Hippocratic dietetics, qi-tonifying herbs, and Ayurvedic rasayana, but also of vitamin chemistry, industrial food processing, deregulated neoliberal markets, and the political economies of transition. Understanding supplements historically and sociologically makes clear that they are not simply neutral tools for health, but products shaped by changing scientific paradigms, economic structures, and cultural ideals of what a “good,” productive, and long life should be.

2. Categories of Supplements

2.1. Sports Foods (Energy, Carbohydrates, Protein)

Sports foods that provide energy, carbohydrates, and protein are now routine in athletic practice, but they sit on a continuum with dietary supplements and share many of the same health and doping risks when misused or contaminated. Understanding both their legitimate role and their potential dangers is essential for athletes who wish to optimize performance without compromising health or violating anti-doping rules.

Table 1: Supplements Category: Sports Foods (Energy, Carbohydrates, Protein)

Supplement Type	Examples	Main Purpose / Use
Sports drinks	Carbohydrate–electrolyte drinks	Hydration, electrolytes, quick energy during exercise
Sports gels & confectionery	Energy gels, chews	Concentrated carbohydrate during prolonged exercise
Isolated protein supplements	Whey, casein, soy, pea, rice blends	Muscle repair and growth
Recovery shakes	Protein + carbohydrate drinks	Post-exercise recovery
Liquid meal supplements & energy bars	Ready-to-drink meals, bars	Convenient energy and nutrient intake
Electrolyte tablets/powders	Sodium, potassium, magnesium blends	Hydration support, fluid balance

Sports foods are products designed to supply convenient energy and nutrients around exercise, often in more practical forms than ordinary meals. The IOC consensus describes them as tools to provide carbohydrates and fluids during and after exercise, support recovery, and meet higher protein needs, especially when eating full meals is impractical. Common examples include:

- Sports drinks (carbohydrate–electrolyte beverages) that provide fluids, sodium, and rapidly absorbed carbohydrates to support endurance performance and hydration.
- Sports gels and chews, concentrated carbohydrate products used during long events when chewing and digestion of solid food is difficult.
- Energy bars and liquid meal supplements that combine carbohydrates, some protein, and micronutrients to provide compact, portable fuel before or after training.
- Protein shakes and powders (often whey or mixed proteins) that help athletes reach daily protein targets to support muscle repair and adaptation.

When used appropriately and integrated into a well-designed diet, these products can make a modest but meaningful contribution to training quality, competition performance, and recovery. However, their convenience and heavy marketing can also encourage overuse, reliance, and a drift towards higher-risk supplement categories like “pre-workouts” and “muscle-building” formulations.

Health risks of sports foods and supplements

Even sports foods that appear simple—drinks, gels, protein powders—carry potential health risks if misused or combined with poorly regulated ingredients.

1. **Gastrointestinal and metabolic problems.** Large intakes of concentrated carbohydrate from drinks, gels, and bars can cause gastrointestinal distress (cramps, diarrhea, nausea), especially if an athlete exceeds gut tolerance or uses unfamiliar products in competition. Very high sugar intakes outside of training may also contribute to dental caries and poor overall dietary patterns if sports foods displace regular meals.
2. **Energy imbalance and body composition issues.** Misjudging the energy content of sports foods can lead to unwanted weight gain if athletes treat them as “free” performance products rather than calorie-dense foods. Conversely, some athletes over-rely on low-calorie sports products while under-eating real food, which can contribute to low energy availability and relative energy deficiency in sport (RED-S), with consequences for bone health, hormones, and performance.
3. **Excess protein and kidney or metabolic load.** For healthy athletes, moderate protein supplements are generally safe, but chronic high intakes far above needs—especially from multiple shakes and bars per day—may contribute to gastrointestinal discomfort and in some cases strain individuals with pre-existing kidney or metabolic conditions. Over-reliance on protein products can also narrow diet quality by displacing whole-food sources that supply fiber, vitamins, minerals, and phytochemicals.
4. **Stimulants and “hidden” ingredients.** Many products marketed as sports foods blur into supplement territory, especially “energy” drinks and pre-workouts that combine caffeine with other stimulants, herbal extracts, and sometimes undeclared substances. High doses of caffeine and other stimulants can raise heart rate and blood pressure, disturb sleep, and in extreme cases cause arrhythmias or other serious events, particularly when multiple products are stacked.
5. **General contamination and quality issues.** Studies of dietary supplements, including sports nutrition products, show that a substantial proportion contain undeclared compounds or different ingredient amounts than stated, which poses both health and doping risks. Undeclared drugs such as sibutramine (a withdrawn weight-loss drug), anabolic steroids, or synthetic stimulants have been detected in a range of products, including those marketed for energy, weight loss, and performance. Such contamination can cause cardiovascular events, liver injury, mood disturbances, and other adverse effects beyond anything expected from legitimate sports foods.

Overall, expert bodies emphasize that sports foods and supplements can offer small benefits only when built on a solid nutrition foundation, and that any potential gains must be weighed against health risks and uncertainties in product quality.

Risks of inadvertent doping

For athletes subject to anti-doping rules, supplement use carries a specific and serious risk: inadvertent ingestion of substances banned by the World Anti-Doping Agency (WADA). Even products that appear to be simple sports foods can be contaminated or cross-contaminated in manufacturing facilities that also handle prohormones, stimulants, or other prohibited substances.

1. **Scale of the contamination problem.** A meta-analysis of 3,132 dietary supplements found that 875 contained undeclared substances, implying that about 28% of the tested products posed a risk of

unintentional doping. Contaminants most commonly included sibutramine, anabolic-androgenic steroids, prohormones, and various stimulants such as 1,3-dimethylamylamine. Surveys of sports nutrition supplements from multiple countries report contamination rates ranging from about 12% to 58%, depending on the product category and sampling strategy.

2. **Contribution to anti-doping rule violations.** Analyses of doping control data estimate that roughly 6.4–8.8% of sanction cases are linked to undeclared substances in dietary supplements. Multi-ingredient pre-workouts, muscle-building supplements, and weight-loss products are highlighted as particularly high-risk categories. Several high-profile cases, including athletes who tested positive for substances like Ostarine, have involved claims of contaminated supplements that were purchased under the assumption of safety.
3. **Responsibility and strict liability.** Anti-doping regulations operate under a principle of strict liability: athletes are responsible for everything found in their body, regardless of intent. This means that even if a product is mislabeled or contaminated, a positive test can still result in suspension, loss of results, damaged reputation, and financial consequences. Sport integrity agencies therefore warn that supplement use is never entirely risk-free and that complete avoidance is the only way to reduce doping risk to zero.
4. **Guidelines to reduce inadvertent doping risk.** Expert statements and anti-doping bodies recommend a risk-benefit analysis for any supplement, starting from the question of whether the athlete truly needs it and whether the effect is evidence-based. When supplements are deemed necessary (for example, targeted sports foods, vitamin D for deficiency, or iron under medical supervision), athletes are advised to:
 - Prefer food-based strategies first and use sports foods mainly for logistical convenience (e.g., fueling during long events).
 - Choose products that are batch-tested by independent quality assurance programs screening for banned substances (e.g., Informed Sport, NSF Certified for Sport), which significantly reduce but do not eliminate contamination risk.
 - Avoid “high-risk” categories such as unregulated pre-workouts, “testosterone boosters,” “pro-hormone” blends, and extreme weight-loss products, especially when purchased online from unknown brands or countries with weak oversight.
 - Keep detailed records of products used (brand, batch, receipts) and consult with sports physicians or dietitians before introducing any new supplement.

International and national anti-doping agencies repeatedly emphasize that nutritional supplements “remain a risk for inadvertent doping,” even with recent improvements in regulation and manufacturing standards. For high-level athletes, the marginal performance advantage from any given sports food or supplement must therefore be weighed against the non-trivial possibility of contamination and anti-doping violations.

In sum, sports foods can be useful tools for delivering energy, carbohydrates, and protein at the right time around exercise, but they are not neutral or risk-free. Health risks from overuse, poor product quality, and

added stimulants intersect with the very real danger of inadvertent doping due to contamination and mislabeling, making cautious, evidence-based, and professionally supervised use essential for any athlete operating under an anti-doping regime.

2.2. Medical Supplements

“Medical” supplements—vitamin and mineral products used to correct or prevent deficiencies—play an important role in athlete health, but their benefits are highly context-dependent and accompanied by real health and inadvertent-doping risks. For most well-nourished athletes with adequate energy intake, routine multivitamin–mineral use offers little performance advantage, while inappropriate or excessive use can cause toxicity and expose athletes to contaminated products.

What are “medical” supplements?

“Medical” supplements are products used primarily to treat or prevent nutrient deficiencies rather than to directly enhance performance, even though corrected deficiency can indirectly improve performance and health. In sport, this category usually includes:

- General multivitamin–mineral tablets taken as “insurance.”
- Single nutrients such as iron, calcium, vitamin D, B12, folate, magnesium, zinc, or sodium, prescribed or recommended based on risk or confirmed deficiency.
- Fortified products (e.g., iron syrup, vitamin D drops, electrolyte tablets) used to manage specific medical or subclinical conditions.

Position statements and reviews emphasize that athletes with adequate energy intake from diverse, nutrient-dense foods generally meet micronutrient needs without supplements. Deficiency risk rises when energy intake is low, diets are restrictive (e.g., weight-class sports, aesthetic sports, vegan diets without planning), or training loads and sweat losses are very high.

When are “medical” supplements useful?

Micronutrients are crucial for energy metabolism, oxygen transport, bone health, immune function, and recovery, so true deficiencies can harm both health and performance. Narrative and systematic reviews highlight several situations where targeted supplementation is justified:

- **Iron** for athletes with iron-deficiency anemia or low ferritin, particularly endurance and female athletes, to restore hemoglobin, VO_2max , and fatigue resistance.
- **Vitamin D and calcium** in athletes with low sun exposure, indoor training, darker skin at high latitudes, or low dairy/fortified intake, to support bone health and reduce stress-fracture risk.
- **B-vitamins** (B12, folate) in vegans, vegetarians, or athletes with documented low status, to maintain red blood cell production and neural function.

- **Magnesium, zinc, sodium** in some athletes with high sweat losses or low dietary intake, when blood tests or diet analysis show suboptimal status.

Recent reviews stress that supplementation should follow laboratory-based diagnosis and professional assessment, not guesswork. The “food-first” principle is widely endorsed: athletes should prioritize balanced diets that meet energy needs and use supplements only to fill verified gaps.

Health risks of “medical” supplement use

Although vitamins and minerals are essential, “more” is not always better; above certain thresholds, they can cause toxicity or other adverse effects. Several health risks are particularly relevant:

1. **Toxicity and side effects from excessive doses.** Reviews of athletes’ supplement practices note that high-dose vitamin and mineral intake can lead to toxic side effects, even when labels are accurate. Examples include:
 - Excess vitamin C (>2,000 mg/day) increasing risk of gastrointestinal upset and kidney stones in susceptible individuals.
 - High vitamin E intake associated with increased risk of hemorrhagic events and possibly prostate cancer at doses near or below the established upper limit.
 - Chronic iron supplementation causing oxidative stress, gastrointestinal symptoms, and possible organ damage in those without deficiency or with underlying conditions such as hemochromatosis.
2. **Masking underlying problems.** Self-supplementation can mask symptoms and delay proper diagnosis. For example, taking iron without medical supervision may temporarily improve fatigue while underlying causes (e.g., gastrointestinal bleeding, celiac disease, heavy menstrual loss) remain untreated. Similarly, relying on multivitamins may give a false sense of security while energy availability, macronutrient intake, or disordered eating patterns remain problematic.
3. **Interference with training adaptations.** Some evidence suggests that high-dose antioxidant vitamin supplementation may blunt beneficial training adaptations by interfering with redox-sensitive signaling pathways, although findings are mixed and dose-dependent. Reviews conclude that in well-nourished athletes, broad micronutrient supplementation does not improve performance and may, in some cases, impair endogenous defense systems or adaptation.
4. **Interactions with medications and other supplements.** “Medical” supplements can interact with drugs (e.g., iron affecting absorption of certain medications, vitamin K interacting with anticoagulants) or with other supplements, complicating treatment and increasing risk when athletes combine multiple products. Without professional oversight, such combinations may quietly increase cardiovascular, bleeding, or metabolic risks.

Professional bodies therefore advise that athletes avoid taking micronutrient supplements “just in case” and instead undergo diet assessment and, where indicated, blood testing to guide precise, time-limited interventions.

Risks of inadvertent doping from “medical” supplements

Vitamins and minerals themselves are not on the WADA Prohibited List, but products marketed as “vitamins,” “multis,” or “health” supplements can still be contaminated, mislabeled, or manufactured in facilities that handle banned substances. This creates a non-zero risk of inadvertent doping even with apparently benign “medical” supplements.

1. **Contamination prevalence.** A meta-analysis cited in recent reviews found that about 28% of tested dietary supplements contained undeclared substances, including anabolic steroids and stimulants. Although contamination risk is highest in weight-loss, muscle-building, and pre-workout products, analyses have also detected undeclared drugs in products sold as multivitamins or “health” supplements, especially from less regulated online sources.
2. **Strict liability and athlete responsibility.** Anti-doping rules apply strict liability: athletes are responsible for any prohibited substance found in their sample, regardless of intent or product labeling. This means that even if a “medical” supplement is marketed as a simple multivitamin, an undeclared contaminant can lead to sanctions, loss of results, and damage to reputation. Reviews and expert statements stress that the only way to reduce doping risk to zero is to avoid all supplements; any use, including vitamins, introduces some risk.
3. **Minimizing inadvertent doping risk with medical supplements.** Given that some athletes truly need medical supplementation, the question becomes how to minimize risk while meeting medical needs. Recommendations include:
 - **Food-first approach:** correct diet and energy intake as the primary strategy; resort to supplements only for documented deficiencies or strong clinical indication.
 - **Use third-party tested products:** choose supplements certified by independent programs that test for banned substances and verify label accuracy, which substantially lowers contamination risk.
 - **Prefer single-nutrient medical-grade products:** iron, vitamin D, or B12 prescribed or supplied through medical channels are less likely to be contaminated than multi-ingredient “performance” or “immune” blends marketed online.
 - **Avoid high-risk categories and dubious brands:** especially multi-claim products (“energy + weight loss + muscle + testosterone”) or those sold exclusively via non-reputable websites.
 - **Document everything and seek professional guidance:** athletes should work with sports physicians and dietitians, keep records of brand, batch, and dosage, and review every product against anti-doping resources before use.

In summary, “medical” supplements can be valuable tools for correcting or preventing true deficiencies in athletes, particularly under conditions of low energy intake, restricted diets, high sweat losses, or limited sun exposure. However, in the absence of diagnosed deficiency, routine micronutrient supplementation does not improve performance and carries risks of toxicity, interference with adaptations, and inadvertent doping

through contamination. For athletes, the safest strategy is a food-first, diagnosis-driven approach, with cautious use of certified, medically indicated supplements under professional supervision.

Table 2: Supplements Category: “Medical” Supplements (Correcting or Preventing Deficiencies)

Supplement Type	Examples	Main Purpose / Use
Multivitamin–mineral	Standard multi formulations	General nutrient coverage when intake is low
Vitamin D	D3 supplements	Bone health, immune function (especially low-sun regions)
Calcium	Calcium carbonate/citrate	Bone strength, often combined with vitamin D
Iron	Ferrous sulfate, gluconate	Treat/prevent iron deficiency (common in endurance & female athletes)
B-complex vitamins	B1, B2, B6, B12, folate, niacin	Energy metabolism support when intake inadequate
Magnesium	Magnesium citrate, oxide	Muscle function, energy metabolism
Zinc	Zinc gluconate	Immune support when deficient
Omega-3 fatty acids	Fish oil, algae oil	Inflammation modulation, recovery
Probiotics	Lactobacillus, Bifidobacterium strains	Gut health support

2.3. Ergogenic Supplements

Ergogenic supplements are products taken with the specific aim of improving performance, over and above simply meeting basic nutrient needs. Among hundreds of marketed products, only a small group has robust evidence of benefit when used correctly, and even these carry health and inadvertent-doping risks that athletes must manage carefully.

Evidence-based ergogenic supplements

Consensus statements and recent reviews converge on a short list of “Group A” or top-tier ergogenic aids: caffeine, creatine, nitrate (e.g., beetroot juice), beta-alanine, and buffering agents such as sodium bicarbonate, with high-quality protein often included as a foundation for adaptation.

1. **Caffeine.** Caffeine is one of the most consistently effective ergogenic aids, improving endurance performance, vigilance, and high-intensity efforts when taken in doses around 3–6 mg/kg body mass about 60 minutes before exercise, or in repeated smaller doses. Meta-analyses and sport-specific reviews (e.g., cycling) report moderate performance benefits, though effects vary by genetics, habituation, and timing.
2. **Creatine monohydrate.** Creatine increases intramuscular phosphocreatine stores, improving repeated high-intensity performance and supporting gains in lean mass and strength during resistance training. Standard protocols involve a loading phase (e.g., ~20 g/day for 5–7 days) followed by a maintenance

dose (~3–5 g/day), though lower chronic dosing can also be effective. Benefits are most pronounced in short, explosive activities, but there is also interest in creatine's roles in recovery and brain function.

3. **Dietary nitrate (beetroot juice).** Nitrate-rich beetroot juice and similar products enhance nitric oxide availability, improving exercise efficiency and, in some cases, endurance performance, particularly in events lasting 5–30 minutes. Protocols typically involve acute dosing 2–3 hours pre-event, or short loading periods, with more consistent benefits in less-trained athletes and in hypoxic conditions.
4. **Beta-alanine.** Beta-alanine increases muscle carnosine, improving intracellular buffering of hydrogen ions and potentially enhancing performance in high-intensity efforts of about 1–4 minutes (e.g., 400–1500 m running, rowing). Effective protocols use divided doses totaling around 4–6 g/day for several weeks to build intramuscular stores.
5. **Sodium bicarbonate.** Sodium bicarbonate acts as an extracellular buffer, improving performance in repeated or sustained high-intensity efforts of 1–7 minutes by counteracting acidosis. It is usually taken in acute doses of ~0.2–0.3 g/kg 60–120 minutes before exercise, but gastrointestinal side effects are common and must be managed by careful trial in training.
6. **Protein (and essential amino acids).** While protein is not an ergogenic “booster” in the same way as caffeine, adequate protein intake (often supported by supplements) is crucial for maximizing training adaptation, muscle protein synthesis, and recovery. Reviews identify protein as one of the “top 5” sports supplements because of its consistent contribution to long-term performance via improved adaptation.

These supplements are recommended only after dietary basics (energy sufficiency, macronutrient distribution, micronutrient adequacy) are in place, and they should be trialed in training to assess individual response before competition use.

Health risks of ergogenic supplement use

Even evidence-based ergogenic aids can cause health problems if misused, overdosed, or combined with other substances.

1. Acute side effects and intolerance

- Caffeine can cause jitteriness, anxiety, gastrointestinal upset, increased heart rate and blood pressure, and sleep disturbances, especially at higher doses or in sensitive individuals. Poor sleep from late caffeine use may ultimately harm adaptation and performance despite short-term benefits.
- Beta-alanine commonly causes paresthesia (tingling), which is benign but uncomfortable; in some athletes, this limits tolerable doses.
- Sodium bicarbonate is notorious for gastrointestinal distress (bloating, nausea, diarrhea) if the dose or timing is not carefully managed.

2. Chronic and long-term concerns

- Creatine is generally considered safe in healthy individuals at recommended doses, but concerns remain about its use in people with pre-existing kidney disease or when combined with dehydration and high-protein diets, making medical oversight advisable.
 - Long-term high-dose caffeine use is linked to cardiovascular strain, sleep disruption, and potential dependence; some pre-workout products deliver doses beyond typical sport-science recommendations, raising safety questions.
 - Prolonged use of high bicarbonate doses, especially alongside sodium-rich diets, may be problematic for athletes with hypertension or cardiovascular risks due to sodium load.
- 3. Redox and adaptation issues.** Emerging “redox” analyses argue that many ergogenic strategies interact with oxidative stress and signaling pathways; while caffeine, creatine, nitrate, and beta-alanine have acceptable profiles at recommended doses, stacking multiple products or adding high-dose antioxidants may disrupt normal adaptation mechanisms. This reinforces the need for targeted, minimal-effective dosing rather than indiscriminate supplementation.

Professional guidelines emphasize that performance-enhancing supplements should only be considered when a strong evidence base supports their efficacy, the athlete’s basic nutrition is optimized, and potential health risks are evaluated.

Risks of inadvertent doping with ergogenic supplements

Because ergogenic products target performance, they are disproportionately represented among contaminated or adulterated supplements, making inadvertent doping a major concern.

1. **High contamination rates in performance products.** A meta-analysis of 3,132 dietary supplements found that 875 (about 28%) contained undeclared substances, including anabolic steroids and stimulants. Reviews and anti-doping reports highlight that contamination is particularly common in muscle-building, weight-loss, and pre-workout products—exactly the categories many athletes use seeking ergogenic effects. Even nominally simple creatine or caffeine products can be produced in facilities that also handle prohormones or designer stimulants, creating cross-contamination risk.
2. **Toxicity and doping together.** Contaminants such as steroids, sibutramine, or synthetic stimulants not only trigger anti-doping violations but also carry serious health risks, including liver damage, cardiovascular events, psychiatric effects, and endocrine disruption. Case reports described in reviews show that even tiny contamination levels (e.g., microgram quantities of prohormones) can push urinary metabolites above WADA thresholds after a single capsule.
3. **Strict liability and career consequences.** Under WADA’s strict-liability principle, athletes are held responsible for any prohibited substance in their body, regardless of whether contamination was intentional or declared on the label. This means that using unverified ergogenic supplements can jeopardize careers, results, sponsorships, and reputations even when athletes believe they are using legal products.

4. **Risk-mitigation strategies.** Expert guidelines from the IOC and others propose a structured risk–benefit analysis before using any ergogenic supplement. Key recommendations include:

- Only consider ergogenic aids with strong evidence (e.g., caffeine, creatine, nitrate, beta-alanine, bicarbonate) and clear performance rationales.
- Use a food-first approach and confirm that basic sports nutrition (carbohydrate availability, protein, energy, hydration) is already optimized.
- Select products that are batch-tested by independent certification programs for banned substances (e.g., Informed Sport, NSF Certified for Sport), recognizing that this reduces but does not eliminate risk.
- Avoid multi-ingredient “proprietary blend” pre-workouts, “testosterone boosters,” and extreme “fat burners,” which are over-represented in contamination cases.
- Trial supplements in training, keep detailed records (brand, batch, dose), and seek guidance from qualified sports nutrition and medical professionals.

In conclusion, a small set of ergogenic supplements—caffeine, creatine, nitrate, beta-alanine, bicarbonate, and high-quality protein—can provide modest but meaningful performance benefits when integrated into a sound nutrition and training plan. At the same time, their use introduces health risks (from side effects, overdosing, and interactions) and a non-negligible risk of inadvertent doping due to contamination, especially when products are poorly regulated or aggressively marketed. For serious athletes, careful product choice, conservative dosing, and professional supervision are essential to ensure that the marginal gains of ergogenic supplementation do not come at the cost of health or eligibility to compete.

Table 3: Supplements Category: Ergogenic Supplements (Evidence-Based)

Supplement Type	Examples	Main Purpose / Use
Creatine monohydrate	Creatine powder	Strength, power, repeated high-intensity efforts
Caffeine	Capsules, coffee, energy gels	Alertness, endurance, high-intensity performance
Beta-alanine	Beta-alanine powder	Buffering capacity (1–4 min high-intensity efforts)
Sodium bicarbonate	Baking soda capsules	Blood acidity buffering in intense events
Nitrate	Beetroot juice	Improved efficiency and endurance
BCAA / EAA	Branched-chain or essential amino acids	Support muscle protein synthesis (when dietary protein marginal)
HMB	Beta-hydroxy-beta-methylbutyrate	Muscle preservation (specific contexts)

2.4. Mixed and emerging evidence supplements

Mixed and emerging evidence supplements sit in a grey zone between clearly effective ergogenic aids and products with no plausible benefit. They often target recovery, inflammation, stress, or “general

performance,” but research findings are inconsistent, and they share the same structural risks of health harm and inadvertent doping as better-known supplements.

What are mixed/emerging evidence supplements?

Mixed/evidence emerging supplements are those for which some plausible mechanisms and positive studies exist, but overall evidence is limited, heterogeneous, or context dependent. In sport, commonly discussed examples include:

- Polyphenol rich products such as tart cherry, blackcurrant, and other berry extracts, used for recovery, soreness, and sleep.
- Herbal adaptogens like ashwagandha, rhodiola, and ginseng, marketed for stress, endurance, and mental performance, but with varying evidence in athletes.
- Coenzyme Q10 and related “mitochondrial” supplements aimed at improving energy metabolism and reducing fatigue.
- Other plant-based antioxidants and “immune” blends that claim to reduce oxidative stress or illness risk, often with limited sport specific data.

Position papers and systematic reviews stress that, unlike creatine or caffeine, these supplements rarely show consistent, meaningful performance benefits across studies, sports, and protocols.

Examples and current evidence

- **Tart cherry and other polyphenols:** Tart cherry has become a model case of an emerging evidence supplement. Polyphenol rich tart cherry juice or extracts may reduce markers of oxidative stress and muscle damage and improve some measures of recovery. A randomized trial using a specialized tart cherry extract showed reduced oxidative stress, lower creatine kinase and cardiac markers, and better grip strength recovery following intense resistance exercise. However, other controlled trials find no meaningful differences in soreness, readiness, or performance compared with placebo, especially with powdered formulations and shorter protocols. Reviews conclude that polyphenol supplementation can, in some cases, modestly enhance recovery and subsequent performance, but effects depend on dose, form (juice vs extract), timing, training status, and outcome measures, and not all studies show benefits. Moreover, many interventions use high calorie juices several times per day, raising questions about energy balance and practicality for weight sensitive athletes.
- **Adaptogens and CoQ10.** Herbal adaptogens such as ashwagandha and rhodiola are often promoted for stress reduction, perceived exertion, and endurance, but sport specific research is limited and mixed. Small studies sometimes report reduced perceived stress or small improvements in maximal oxygen uptake, but methodological limitations and heterogeneity prevent firm conclusions for athletic performance. Coenzyme Q10 has plausible roles in mitochondrial function and antioxidant defense, and some studies in clinical and general populations report reduced fatigue, yet evidence in trained athletes is inconsistent and often shows little or no performance enhancement.

Overall, these supplements may help specific individuals in specific contexts, particularly where baseline diet or status is poor, but the group level sport science evidence remains “promising but not definitive” rather than clearly ergogenic.

Health risks of mixed/emerging evidence supplement use

Because many of these products are perceived as “natural” and benign, athletes may underestimate their health risks, especially at high doses, over long durations, or in combination with other supplements.

1. **Unknown optimal dose and long-term safety.** For tart cherry and other polyphenols, most studies are short term (days to weeks) and focus on biochemical markers and acute performance, not long term health outcomes. High dose antioxidant intake could theoretically blunt beneficial training induced redox signaling, though data are mixed and product specific. For herbal adaptogens, the safety profile over months or years, particularly in combination with other medications, is not well established.
2. **Gastrointestinal and metabolic issues.** Many mixed evidence supplements are delivered as juices or syrups with significant sugar and energy content; frequent high calorie dosing can contribute to unwanted weight gain or dental issues if not integrated into total energy planning. Concentrated extracts may cause gastrointestinal discomfort, particularly if consumed around exercise or in large doses.
3. **Herb–drug interactions and individual variability.** Herbal products can interact with medications via cytochrome P450 and other pathways, altering drug levels or effects, which is a concern for athletes on prescription drugs (e.g., asthma, depression, contraception). Individual responses to adaptogens and polyphenols vary widely, so a dose that seems harmless for one athlete may cause sleep disturbance, GI issues, or mood changes in another.
4. **Opportunity cost and misplaced focus.** Heavy reliance on mixed evidence supplements can distract from core determinants of performance—training quality, sleep, energy availability, and basic nutrition—and may encourage a “pill for every problem” mentality. Money and attention flow into marginal, uncertain benefits while more powerful, low risk interventions are neglected.

Given these uncertainties, expert groups generally recommend that athletes view such supplements as experimental, to be used cautiously, if at all, and only after foundational nutrition is optimized.

Inadvertent doping risks with mixed/emerging evidence supplements

From an anti-doping perspective, mixed evidence supplements can be just as risky as clearly ergogenic products because they share the same supply chains and regulatory gaps.

1. **High contamination prevalence in heterogeneous products.** Mixed evidence supplements are often sold as multi-ingredient blends—“recovery complexes,” “superfood antioxidants,” “adaptogen stacks”—manufactured in facilities that also produce weight loss, muscle building, or stimulant products. A meta-analysis of 3,132 dietary supplements found that 875 contained undeclared substances, implying about a 28% risk of contamination for non-certified products, with sibutramine, anabolic steroids, and other drugs among the most common. Reviews from 12 countries show

contamination rates from 12% to 58% across diverse supplement categories. Even “health” products like vitamin tablets have been cross contaminated with steroids when produced on shared lines, and a single capsule of a tainted supplement has been enough to push steroid metabolites above WADA thresholds in urine tests. This demonstrates that any supplement, including seemingly benign antioxidant or adaptogen blends, can become a doping risk if manufacturing practices are poor.

2. **Complex formulations and obscure ingredient names.** Multi ingredient emerging evidence supplements often list dozens of botanicals and trademarked proprietary blends, sometimes using alternative or obscure names for compounds that may be banned. Athletes may not realize that a particular plant extract or chemical synonym appears on the Prohibited List, or that related analogues are effectively treated as banned substances. This complexity increases the chance of unintentional rule violations.
3. **Systemic risk along the supply chain.** Recent work using systemic risk assessment shows that many doping risks enter long before the athlete buys the product—during raw material sourcing, manufacturing, and labeling. Economic incentives to “spike” products with pharmacological agents (e.g., stimulants, prohormones) to create noticeable effects are particularly strong in competitive markets for “new” or “breakthrough” supplements, which many mixed evidence products claim to be. Athletes at the end of this chain have limited capacity to detect such practices.
4. **Strategies to reduce inadvertent doping risk.** Experts recommend the same basic protections for mixed evidence supplements as for classic ergogenic aids, with extra caution because the benefits are less certain. Key strategies include:
 - Question necessity first: if evidence is weak and benefit small, the added doping risk often outweighs potential gains; often the safest choice is not to use such products.
 - Prefer single ingredient, food like products (e.g., standardized tart cherry extract) from reputable manufacturers over complex multi-ingredient blends with proprietary formulas.
 - Use third party tested supplements that are batch certified for absence of banned substances, recognizing that this reduces but does not completely remove risk.
 - Avoid high risk marketing cues such as extreme claims (“legal steroid,” “pharmaceutical grade gains,” “rapid fat shredding”), which correlate with doping relevant contamination.
 - Document use and consult professionals, including sports dietitians and medical staff, before introducing any emerging evidence supplement.

In sum, mixed and emerging evidence supplements occupy an ambiguous space: scientifically intriguing, heavily marketed, but only inconsistently beneficial and embedded in a high-risk supplement economy. For athletes operating under anti-doping rules, the combination of uncertain performance gains, incomplete safety data, and substantial contamination risk means that such products should be approached with skepticism and, in many cases, avoided in favor of well supported nutrition strategies and a small, carefully controlled set of proven aids.

Table 4: Supplements Category: Other Frequently Used (Mixed/Emerging Evidence)

Supplement Type	Examples	Main Purpose / Use
Coenzyme Q10	CoQ10 capsules	Cellular energy support
Ashwagandha	Herbal extract	Stress modulation, possible strength benefits
Glucosamine & chondroitin	Joint formulas	Joint health support
Polyphenols	Tart cherry, berry extracts	Recovery and reduced soreness
Menthol	Cooling sprays/drinks	Perception of cooling in heat
Ketone supplements	Ketone esters/salts	Experimental ergogenic use

3. Information for Parents

Parents are often the first line of protection for young athletes. Supplements promise faster gains, better focus, or more energy—but they also bring real health risks and a serious danger of accidental (inadvertent) doping that can harm your child’s body and their sports future. This essay explains, in clear language, what you need to know to guide your child safely.

3.1. What are supplements—and why are kids using them?

“Dietary supplements” include any pills, powders, drinks, or gummies that provide concentrated nutrients or substances on top of normal food. Common examples for young athletes are:

- Protein powders and shakes
- Energy drinks, “pre-workouts,” and “focus” drinks
- Creatine and “muscle-building” products
- Multivitamins and single vitamins (vitamin D, C)
- Herbal products (ginseng, ashwagandha, “immune boosters”)
- Fat burners, metabolism boosters, “testosterone boosters”

Studies show that many teenagers already use at least one supplement, and some use several at the same time—often without their parents or coaches fully realizing it. They might buy them online, in supermarkets, gyms, or be given samples by older athletes.

Why do they use them?

- Belief that supplements are necessary to be “serious” or competitive
- Influence from social media, influencers, and marketing

- Pressure from peers or older teammates
- Desire for quick fixes: more muscle, less fat, more energy

As a parent, your job is not to memorize every product on the market, but to understand the types of risks and to help your child make safer, more informed decisions.

3.2. The basic rule: food first, supplements only if really needed

All professional sports and medical organizations agree on one key principle: good food, enough energy, sleep, and training are far more important than any supplement. For most young athletes:

- A balanced diet with enough calories, carbohydrates, protein, fruits, vegetables, and dairy/fortified alternatives covers their needs.
- Supplements usually add little or nothing to performance if the basics are solid.
- Supplements cannot fix a poor diet, lack of sleep, overtraining, or stress.
- There are a few exceptions where a doctor or sports dietitian might recommend a supplement:
- Vitamin D in winter/low sunlight regions
- Iron if blood tests show deficiency
- Calcium if dairy intake is very low
- A carefully dosed sports drink or gel in long endurance competitions

But even in those cases, the decision should come from a health professional, not from advertising or peer pressure.

3.3. Health risks of supplement use in young athletes

Supplements can harm your child's health in several ways.

Too much of a "good" thing: vitamin and mineral overdose

Vitamins and minerals are essential, but at high doses they can be toxic. Examples:

- **Iron:** Necessary when a true deficiency exists, but harmful if taken without need. Excess iron can damage the liver and other organs and cause stomach pain, nausea, and constipation.
- **Vitamin D and A:** High doses over time can cause high calcium levels, bone problems, kidney damage, headaches, and other symptoms.
- **Vitamin C:** Large doses can cause diarrhea, nausea, and in some people may increase risk of kidney stones.

Children and teenagers are more vulnerable because their bodies are smaller and still developing. A “megadose” designed for adults may be far too much for a 14-year-old.

Guidance for parents:

- Do not give high-dose vitamin or mineral supplements “just in case.”
- If a doctor prescribes a supplement, follow the dose exactly and keep products out of reach, like medicine.

Stimulants and energy drinks

Many products marketed to athletes contain caffeine and other stimulants, sometimes in high and poorly labeled amounts. This includes:

- Pre-workout powders
- Energy drinks and energy shots
- Some “fat burners” and metabolism boosters
- Risks for young athletes:
- Rapid heart rate and high blood pressure
- Sleep problems, anxiety, and irritability
- Headaches, tremors, and, in extreme cases, arrhythmias and heart events

Because teenagers’ nervous and cardiovascular systems are still developing, they are particularly sensitive. Mixing energy drinks with other caffeinated products (coffee, cola, pre-workouts) increases risk.

Parent advice:

- Treat energy drinks and pre-workouts like risky stimulants, not harmless soft drinks.
- A safe default is: no pre-workouts or energy shots for children and teens, and very cautious use of caffeine in older teens, only after talking with a health professional.

GI (stomach) problems and weight issues

Concentrated sports products can upset the digestive system and disrupt healthy weight.

Large quantities of sports drinks, gels, and bars can cause stomach cramps, diarrhea, or nausea, especially if used outside hard training or without practice.

Many “recovery” shakes and drinks are high in sugar and calories. If used on rest days or in addition to full meals, they can lead to unwanted weight gain.

On the other side, some young athletes use supplements (like “fat burners” or appetite suppressants) to lose weight quickly, increasing the risk of eating disorders and RED-S (Relative Energy Deficiency in Sport), which harms growth, bone health, and hormones.

Parents should watch for:

- Sudden changes in eating patterns
- Rapid, unexplained weight loss or weight gain
- Strong anxiety about body shape or food
- Heavy reliance on shakes, bars, or powders instead of normal meals

Masking serious health problems

Supplements can hide important warning signs. If a teen feels constantly tired, mood is low, or performance drops, they might take:

- More caffeine or pre-workout
- Iron “for energy”
- B-vitamin shots or pills
- Herbal “stress” products

This can temporarily cover up symptoms while the real issue—such as anemia, depression, infection, heart issues, thyroid disease, or overtraining—goes untreated.

As a parent, you should:

- Take persistent fatigue, pain, or mood changes seriously.
- Encourage a check-up with a doctor instead of buying more supplements.
- Remember: if a problem is big enough to need pills, it’s big enough to need a proper diagnosis.

Interactions with medications

If your child takes medication (e.g., for asthma, ADHD, depression, acne, allergies), supplements can interfere:

- Some herbal products change how the liver processes drugs, making them weaker or stronger than intended.
- High doses of certain vitamins and minerals may affect absorption of medications.

Always tell your child’s doctor about all supplements they take, including “natural” or sports products.

3.4. Inadvertent (unintentional) doping: how “normal” supplements can cause a ban

For athletes once they enter a regulated competition system (national teams, international events, some youth leagues), supplements carry another risk: failed doping tests, even without intent to cheat.

What is inadvertent doping?

Inadvertent doping means an athlete tests positive for a banned substance without meaning to use it. The most common way this happens is through contaminated supplements.

Contamination can happen when:

- A factory makes legal supplements and banned substances on the same equipment and doesn't clean properly.
- A company secretly adds drugs (like steroids or strong stimulants) to make a product "work" better.
- Labels are misleading, incomplete, or intentionally false.

How common is contamination?

Recent research has shown the problem is significant: In one large analysis of 3,132 supplements, 875 products contained undeclared substances—around 28%. Studies from different countries report contamination or mislabeling in 12–58% of tested supplements, especially in products for muscle gain, weight loss, and pre-workout stimulation.

A 2025 review found that contaminated supplements were responsible for 6.4–8.8% of all positive doping tests, and one analysis suggested that up to a quarter of anti-doping violations over many years involved supplements. This means that even if your child never intends to cheat, one contaminated pill can be enough to trigger a positive test.

Strict liability: "I didn't know" is not a defense

Under anti-doping rules (like those of WADA):

- Athletes are strictly liable for any banned substance found in their body.
- It does not matter if the substance was on the label, recommended by a coach, or hidden in a supplement.
- Saying "I didn't know" or "it wasn't on the label" rarely prevents a ban, though it might slightly reduce the length.

Consequences can include:

- Suspension from competition (months to years)
- Loss of medals, titles, or records
- Damage to reputation and future opportunities
- Emotional stress and stigma for the whole family
- For a young athlete, this can be devastating—and it can happen from a product bought in a normal shop or online store.

3.5. Why the system is risky, especially for young people

Experts describe the supplement/doping situation as a systemic risk, not just a matter of individual responsibility. Key factors include:

- Weak regulation: In many countries, supplements are regulated more like foods than drugs, meaning they do not need strong proof of safety or effectiveness before sale. Testing can be minimal.
- Economic incentives: It is profitable to spike products with real drugs, because they “work” more obviously and get good reviews.
- Aggressive marketing: Young athletes are targeted with messages about “legal steroids,” “extreme muscle gain,” “fat shredder,” or “limitless focus.”
- Knowledge gaps: Many teenagers, parents, and even some coaches do not realize how often contamination happens or how strict doping rules are.
- This is why simply telling young athletes “be careful” is not enough. They need clear rules and support from adults.

3.6. Practical guidance for parents: how to protect your child

Start with open, non-judgmental conversations

Many young athletes hide supplement use because they fear parents will just say “no,” or they feel ashamed. To keep them safe, you need honest communication. Thus try:

- “I know supplements are everywhere in sport. Can we look at what you’re taking together, so we can keep you healthy and safe?”
- “If you ever feel pressure to use something, I want you to tell me. I won’t be angry; we’ll figure it out together.”
- Make it clear you are on their side, not just policing them.

Simple household rules about supplements

You can set family rules such as:

- No supplements without parental knowledge.
- Your child must show you any product and where they got it.
- No “hard” categories for minors:
- No pre-workout stimulants
- No fat burners or “testosterone boosters”
- No “legal steroid” or “prohormone” products

- Medical supplements only with professional guidance.
- Iron, vitamin D, or other medical-type supplements only after a doctor's exam and lab tests.
- Food first.
- Emphasize regular meals and snacks to support growth and performance. Protein shakes or sports drinks are tools occasionally used around hard training, not daily staples.
- These rules protect health and reduce doping risk.

Check products carefully when supplementation is justified

If, after talking with a sports doctor or dietitian, a supplement is approved (for example, iron for anemia, vitamin D in winter, or specific sports foods for competitions), you can still lower risk:

- Choose simple products: Single vitamins/minerals or basic sports foods (carb drinks, plain whey protein) from known brands are safer than multi-ingredient "stacks."
- Look for third-party certification: Some programs test batches for banned substances and label them (e.g., Informed Sport, NSF Certified for Sport). These are not perfect, but they greatly reduce doping risk.
- Avoid red-flag marketing: Stay away from anything described as "extreme," "hardcore," "legal steroid," "testosterone booster," "anabolic," or "fat shredder."
- Buy from reliable sources: Avoid unknown websites, marketplaces with many unverified sellers, or "back-of-the-gym" products.
- eKeep records: Save receipts, take photos of labels and batch numbers, and note when the product is used. This can be important if there is ever a problem.

Always involve your child in this process so they learn how to evaluate products themselves.

Encourage asking professionals, not the internet

- Help your child build a habit: before starting any supplement, ask a qualified person.
- Good contacts include:
 - Team or club sports dietitian (if available)
 - Team doctor or family doctor with sports experience
 - Certified sports nutritionist or physiologist
- If your child's environment does not have these, you as the parent may need to play a stronger role in critical evaluation, using trusted educational resources from national anti-doping agencies or sport federations.

3.7. Supporting long-term development, not short-term shortcuts

As a parent, your priority is your child's long-term health and well-being, not just today's results. Supplements often promise short-term changes; the real work of sport is long-term. Healthy focus points you can reinforce:

- Skill development: better technique, tactical understanding.
- Smart training: consistent, age-appropriate load, not “crash” plans.
- Recovery habits: enough sleep, active recovery, time off.
- Balanced life: school, friends, family, hobbies beyond sport.
- Positive body image: valuing strength, health, and function, not unrealistic body ideals.
- Remind your child that many champions succeed on the foundation of good food, smart training, and patience, not on the latest supplement trend.

3.8. Key messages for parents to remember

- Supplements are not necessary for most young athletes.
- A good diet, sleep, and training plan are more powerful and safer.
- Health risks are real, especially for children and teens.
- Overdoses, heart strain, stomach problems, eating disorders, and drug interactions are possible.
- Inadvertent doping is a serious threat.
- Many supplements are contaminated; one pill can cause a failed doping test, even if your child never meant to cheat.
- Rules for your family help.
- No secret supplements, no high-risk categories, medical products only with professional advice.
- You are your child's best advocate.
- Stay involved, ask questions, read labels together, and seek expert help when needed.
- Teach critical thinking, not fear.
- The goal is not to terrify your child but to help them understand risks and make informed choices.
- By staying informed and engaged, parents can turn the confusing world of supplements into an opportunity: a way to teach young athletes about health, responsibility, and integrity in sport.

Additional Recommended Material

1. WADA's Parents' Guide to Support Clean Sport, available at: <https://www.ausport.gov.au/ais/nutrition>

2. Your role as a parent or guardian, available online at:
<https://www.sportireland.ie/sites/default/files/media/document/2025-12/Parents%20Guide%20to%20Clean%20Sport.pdf>

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Glossary of Key-terms

Term	Definition
Adaptogens	Herbal substances, such as ashwagandha or ginseng, traditionally used to help the body resist stressors and promote longevity; modern equivalents of "qi-tonifying" formulas.
Antidoping Rule Violation (ADRV)	A breach of competitive sports regulations, often caused by the presence of a prohibited substance in an athlete's sample, which can result in suspension.
Batch Testing	A quality control process where specific lots of a supplement are independently screened for banned substances to reduce the risk of contamination.
Beta-alanine	An ergogenic aid used to increase muscle carnosine levels to buffer hydrogen ions during high-intensity exercise; often causes a benign tingling sensation called paresthesia.
Contamination	The presence of undeclared substances in a supplement, which can occur through shared manufacturing equipment, poor quality control, or intentional "spiking."
Creatine Monohydrate	A well-supported ergogenic supplement that increases intramuscular phosphocreatine stores, aiding in repeated high-intensity performance and muscle gain.
DSHEA	The 1994 Dietary Supplement Health and Education Act; U.S. legislation that categorized supplements as food and limited the FDA's pre-market regulatory power.
Ergogenic Aid	Any substance or technique taken with the specific intent of improving athletic performance beyond meeting basic nutritional needs.
Inadvertent Doping	The unintentional ingestion of a prohibited substance, often due to mislabeled or contaminated dietary supplements.
Nitrate	A compound found in products like beetroot juice that enhances nitric oxide availability, improving exercise efficiency and endurance.
Polyphenols	Plant-based compounds (e.g., in tart cherry juice) used to reduce oxidative stress and muscle damage, though evidence for their performance benefits remains mixed.
RED-S	Relative Energy Deficiency in Sport; a condition of impaired physiological function caused by low energy availability, which supplements can sometimes mask.
SARMs	Selective Androgen Receptor Modulators (e.g., Ostarine); a category of prohibited substances sometimes found as undeclared contaminants in muscle-building products.

Strict Liability	The legal and ethical principle in anti-doping where an athlete is responsible for any substance in their body regardless of how it was consumed.
Third-Party Certification	Verification by independent organizations (e.g., Informed Sport, NSF) that a supplement's label is accurate and the product is free of banned contaminants.