

Ergogenic Aids

Michael J. Stuart MD
IIHF Medical Committee

Ergogenic aids are mechanical, pharmacological, physiological, nutritional and psychological means to improve performance, remove psychological constraints, and increase the speed of recovery from training & competition.

Dietary Supplements are products taken by mouth that contains vitamins, minerals, botanicals, amino acids, enzymes, organ tissues, glandulars, & metabolites produced as tablets, capsules, softgels, gelcaps, liquids, powders or bars.

Performance Enhancing Drugs (PEDs) are commonly referred to as “Doping” and typically used in reference to anabolic steroids, beta-2 agonists, human growth hormone, erythropoietin, stimulants & masking agents.

Our Youth Athletes are at risk!

- Over 30 million children & adolescents participate in organized sports
- Increased specialization + financial investment + parental pressure = unrealistic expectations & win at all costs!
- Young athletes seek stimulants, steroids & prescription drugs
- Coaches overtly or covertly promote ergogenic aids
- Negative role modeling from Pros & Olympians influence behavior
- Athletic trainers, physical therapists & physicians may facilitate

I. WADA Prohibited Substances

- Anabolic agents (steroids)
- Hormone & related substances
- Beta-2 Agonists
- Hormone antagonists & modulators
- Diuretics & other masking agents
- Stimulants
- Narcotics
- Cannabinoids
- Glucocorticosteroids

Steroids

- Used by over 1/2 million 8th, 9th & 10th graders
- Most commonly abused by males between age 19-40

A. Effects

- Promote cell growth & division → increase protein synthesis, muscle mass, appetite & bone growth
- Cosmesis, strength gain, recovery from training & competition

B. Side Effects

- Hypertension
- Increase risk of stroke
- Blood clotting
- Liver cancer
- Elevated Cholesterol
- Kidney Damage
- Heart Disease
- Physeal Closure
- Hepatitis / HIV

II. Legal Dietary Supplements

- Creatine
- Amino Acids/Protein
- Carbohydrates
- Vitamins/Minerals
- Caffeine

A. Marketed to adolescents & athletes for performance enhancement with appealing, yet unsubstantiated Claims

- “enhances focus, mood and energy levels”, “stimulate superior power, strength, and endurance”, “superior recovery, increased lean mass, decreased fat mass”, “no estrogen increase, increased libido, no masculinizing side effects”
- “FDA Approved”, “No Side Effects”, “Amazing Medically-Documented Results”, “Clinically Proven”

B. Prevalence

- Survey of 3248 high school students: 71% use at least 1 supplement (Med Sci Sports Exerc 2008)
- Survey of 582 elite Canadian athletes in 27 sports: 88% use at least 1 supplement (Clin J Sp Med 2007)
- Survey of Division 1 collegiate ice hockey players; 58% have used stimulants, 38% used ephedrine at least once, 33% would use a banned substance if it would help them get to the NHL (Physician & Sp Med 2004)



C. Dietary Supplements are not regulated by the FDA

- No required testing or approval to sell
- No provisions for safety or effectiveness
- A “food”, not a “drug”

D. Responsibilities of the Manufacturers

- To ensure that their dietary supplement products are “safe”, the ingredient list are accurate, and that the content matches the amount declared on the label
- Not currently required to record, investigate or forward to the FDA any reports of injuries or illnesses related to their products

III. Four Important Questions

1. Legal vs. Banned

Regulatory Organizations

- WADA (World Anti-Doping Agency)
- USADA (United States Anti-Doping Agency)
- NCAA (National Collegiate Athletic Association)
- IOC (International Olympic Committee)
- Professional Leagues (MLB, NFL, NHL etc.)
- National Governing Bodies (USA Cycling, USA Hockey etc.)
- Illegal/Prohibited - example: anabolic/androgenic steroids & precursors (Anabolic Steroid Act of 2004)
- Legal/Prohibited- example: ephedrine, bumetanide
- Legal/Permitted- example: topical steroids, pseudoephedrine
- CAUTION: Combination cold medications may contain prohibited substances
- Legal/Permitted/Therapeutic Use Exemption (TUE) required- examples: inhaled Beta-2 agonists, insulin
- Legal/Permitted/Declaration of Use required- example: intra-articular steroid injections

Approximately 1% of the total drug tests conducted for all banned substances are positive- usually for anabolic steroids resulting from intentional or unintentional use

- 81% (85 of 105) in 2002-03
- 64% (46 of 72) in 2003-04
- 48% (51 of 106) in 2004-05

2. Pure vs. Tainted: Ignorance is not an alibi!

- All ingredients must be declared on the label of a dietary supplement- ingredients not listed on the "Supplement Facts" panel must be listed in the "other ingredient" statement beneath the panel. However, dietary supplements may contain non-listed ingredients or contaminants

Banned substances (anabolic steroids, ephedrine)

- 634 non-hormonal nutritional supplement from 13 countries & 215 different suppliers bought in stores and from the internet: 15% contained anabolic androgenic steroids not listed on the label (Int J Sport Med 2004)
- 103 dietary supplements (creatine, prohormones, mental enhancers, amino acids) bought on the internet: 17% contained substances not listed on the label- 3 supplements contained a high amount of anabolic steroid (Scan J Med & Sciences 2006)
- Deliberate or unintentional steroid use by football student-athletes from various drug use studies:
 - 1989 - 9.7%
 - 1993 - 5.0%
 - 1997 - 2.2%
 - 2001 - 3.0% (? increase due to ↑ steroid precursors marketing)
 - 2005 - 2.3%

Contaminants (pharmaceuticals, toxic plants, pesticides, bacteria, heavy metals)

- 29 herbal supplements purchased from stores were analyzed microbiologically: antibiotic resistant bacteria and pathogens detected (J of Food Protection 2008)
- 46 ginseng supplements purchased from stores were tested for mold, yeast and bacteria: 48% of American root samples contained molds, 50% of extract samples contained bacteria. (note: ginseng is commonly found in energy drinks) (Int J of Food Microbiology 2006)
- Deliberate or accidental: Any athlete who takes a vitamin, mineral, herb, amino acid, or other dietary supplement does so at his or her own risk of committing a doping violation. The athlete is always responsible for what he or she puts into his or her body.
- Certification Labs provide some support:

The NSF Certified for Sport™ <http://www.nsf.org/>

The nation's first truly independent testing standard and product certification program strictly for dietary supplements. NSF developed and maintains the only accredited American National Standard to certify dietary supplements: NSF/ANSI Standard 173. NSF certifies that participating manufacturers and their products have met stringent independent certification process guidelines.

- Product testing & label content confirmation
- Production facility and supplier inspections
- Protect against adulteration of products
- Identify athletic banned substances in the finished product

To meet the growing demands of athletes, coaches and sports medicine professionals, the new NSF Athletic Banned Substances Certification Program (Certified for Sport™: <http://www.nsf.org/Certified/BannedSub/listings.asp>) minimizes the risk that a dietary supplement or sports nutrition product contains banned substances. The specially designed NSF Mark on each product label signifies that a dietary supplement has met NSF's comprehensive program guidelines.

NSF partnered with the NFL and the NFLPA to develop and administer the NFL/NFLPA Supplement Certification Program designed especially for professional football.



INFORMED-CHOICE <http://www.informed-choice.org/home.php>

The only supplement testing program that uses a “WADA-experienced” lab and ISO 17025 accredited analytical methods to analyze for banned substances within top level sports. The analysis conclusions apply only to the list of tested drugs and to the portion of the batch of product tested. Prospective users of any product on this directory should be aware that inclusion on the directory is not a guarantee that the use of the product will not result in a positive urine/blood dope test- ultimate responsibility lies with the user.

3. Safe vs. Dangerous

- Complications: dehydration, muscle cramps, coronary artery spasm/thrombosis, cardiomyopathy, acute cholestatic liver injury, cirrhosis, thyrotoxicosis, nephrotoxicity, nephrolithiasis, rhabdomyolysis, hepatorenal syndrome
- Medication interactions & Polypharmacy

Examples:

		Combined with:	May cause:
Ephedra (Ma Huang, Ephedrine, Pseudo-ephedrine)	for asthma, cough, fatigue, energy boost, weight loss	Some heart medications, general anesthesia, some antidepressants; medicines that increase blood pressure, other decongestants and/or stimulants	Seizures, arrhythmia, tachycardia, hypertension, stroke, myocardial infarction
Ginseng	for energy boost, stress reduction	Anticoagulants, antiplatelet agents, stimulants, antihypertensives, some antidepressants, digoxin, may increase the effects of steroids and estrogens.	Bleeding, arrhythmia, tachycardia hypertension, mania.

4. Effective vs. Placebo

By law, manufacturers can make three types of claims for their dietary supplement products: health claims, structure/function claims, and nutrient content claims. Some of these claims describe: the link between a food substance and disease or a health-related condition; the intended benefits of using the product; or the amount of a nutrient or dietary substance in a product. The responsibility for ensuring the validity of these claims rests with the manufacturer, FDA, and, in the case of advertising, with the Federal Trade Commission.

- Unknown or variable results
- Nutritional alternatives- equivalent results with a balanced, individualized diet

VI. Common Supplements

A. Multivitamins, B Complex

- No proven effect on performance
- Vitamin A, D, B₃, B₆ can be toxic at excessive doses
- Recommended for athletes with dietary deficiencies

- B.** Vitamin C
- Possible antioxidant benefits with enhanced immune resistance
- C.** Vitamin E
- Antioxidant protection at high altitudes under hypoxic conditions
- D.** Copper, Zinc, Magnesium, Calcium, Iron
- No proven effect on performance
 - Excessive intake can cause nausea, vomiting, diarrhea
 - Recommended for athletes with dietary deficiencies
- E.** Chromium
- Possible increase in lean body mass
 - Some preparations contain ephedrine or Ma Huang (banned!)
 - Recommended for athletes with dietary deficiencies
- F.** Creatine
- Increase muscle phosphocreatinine → enhance mitochondrial creatine kinase activity → increase the rate of aerobic re-synthesis of adenosine triphosphate (ATP)
 - An effective supplement for short-duration, maximum effort anaerobic events
 - 70% of peer-reviewed studies show benefits: enhance lean body mass, muscle strength, power, high-intensity exercise endurance, speed recovery
 - Appears safe, but cumulative or long-term effects are unknown.
 - May contribute to cramping, muscle strains and dehydration- if water intake inadequate
- G.** Branched Chain Amino Acids: leucine, isoleucine, valine
- Increased mental endurance and physical power
 - May inhibit absorption of other amino acids and cause GI upset
 - Recommended for highly trained athletes in prolonged endurance events
- H.** Beta-Hydroxy-Beta-Methylbutyrate (HMB)
- Metabolite of leucine
 - Unknown mechanism of action- possible protein breakdown suppressor
 - No proven side-effects
 - May have an effect for untrained individuals: enhances strength by preventing exercised-induced muscle damage, lowers cholesterol, LDL and blood pressure
- I.** Beta Alanine
- Carnosine buffers muscle cell acid
 - Reduced muscle burn, Delayed fatigue
 - Alternatives: hydration & carbohydrates

J. Nitric Oxide

- Derived from arginine
- Vasodilatation with improved blood and nutrient delivery to muscle
- May cause headaches, light-headedness, increased blood pressure
- Alternatives: hydration, vitamins & minerals

K. Stimulants

- Banned in competition: amphetamines, ephedrine, Ma Huang, synephrine, bitter orange, citrus aurantium, zhi shi
- Permitted: caffeine, guarana, green tea extracts
- Stimulate release of norepinephrine- vasoconstriction and increased blood pressure
- Resistance to fatigue, mood elevation, improvements in maximum torque, peak power and lung function
- Dehydration, tachycardia, nervousness, laxative effects, sleep disturbance, anxiety, tremor, insomnia, aggressiveness, hallucinations, addiction, increased risk of stroke, heart attack, cardiac arrhythmia, and sudden death.

L. Energy Drinks

- Contain a blend of sugars and electrolytes
- May be helpful with activity that lasts over 60 minutes

M. Stimulant Drinks

- May or may not contain sugars and electrolytes- always contain a major dose of many different stimulants
- Provide short-term energy boost- accelerates consumption of fuel stores
- Depletes energy that comes from carbs, fats, proteins, hydration and rest

VI. What can We do to Help?

A. Don't contribute to the problem

Recognize Abuse

- Learn the symptoms & signs
- Identify the susceptible athlete
- Ask your patients questions
- Consider using a questionnaire on Performance Enhancing Substances for your team or patients

Be alert for Symptoms

- Personality change/mood swings
- Euphoria/failure to recognize injury
- Aggression/hostility/temper flares
- Physical/verbal abuse

- Anxiety/tremor/insomnia
- Defiance of rules
- Depression
- Decreased or increased appetite

Be alert for Signs

- Rapid gain in weight & muscle
- Tendon strain/rupture
- High blood pressure
- Acne
- Stretch marks
- Premature balding
- Severe headaches
- Reluctance to talk about PEDs

Women:

- deep voice
- facial hair
- shrinking breasts
- menstrual irregularities

Men:

- breast enlargement
- testicular atrophy

Be alert for Susceptibility

Injured athlete

- Pain
- Depression
- Return to play

Misguided athlete

- Climb the competitive ladder
- Win at all costs

B. Educate Others

Athletes, Coaches & Parents

- Describe the physical, psychosocial, legal & ethical consequences
- Use lectures, articles, brochures, posters, DVDs
- Promote Internet web-sites (reference list attached)
- Ask athletes to seek your advice



- Don't provide nutritional supplements or stimulants
- Communicate expectations to players, parents, coaches and officials and promote their commitment to remain clean : Athlete Pledge for Clean Sport and Fair Competition (USADA)
- Educate Sports Medicine colleagues
- Form a Multidisciplinary Task Force to educate students, residents and allied healthcare professionals
- Organize a conference with physicians, athletic trainers, physical therapists, nurses, PA's, dietitians etc.
- Join Professionals Against Doping in Sports (ACSM & USADA) to support ethical behavior, promote anti-doping education, participate in ACSM & other activities

VII. Summary

Council your athletes on:

- safety concerns
- potential side-effects
- limited effectiveness data
- doping control risk
- nutritional alternatives

Promote a balanced, individualized diet



References/Resources

1. National Collegiate Athletic Association (NCAA):
<http://www.ncaa.org/wps/ncaa?ContentID=1446wada-ama.org>
2. United States Anti-Doping Agency (USADA):<http://www.usantidoping.org/>
3. World Anti-Doping Agency (WADA): <http://www.wada-ama.org/en/>
4. NSF- The Public Health and Safety Company: <http://nsf.org/>
5. Informed Choice: <http://www.informed-choice.org/home.php>
6. National Institute of Health (NIH): <http://dietary-supplements.info.nih.gov/>
7. Office of National Drug Control Policy:
<http://whitehousedrugpolicy.gov/policy/index.html>
8. Tips For The Savvy Supplement User:
<http://www.cfsan.fda.gov/~dms/ds-savvy.html>
9. Claims That Can Be Made for Conventional Foods and Dietary Supplements:
<http://www.cfsan.fda.gov/~dms/hclaims.html>
10. International Association of Athletic Federations:
<http://www.iaaf.org/antidoping/news/index.html>
11. Natural Medicines Comprehensive Database <http://www.naturaldatabase.com/>
12. ConsumerLab.com: <http://www.consumerlab.com/>
13. The National Center for Drug Free Sport Inc.: <http://drugfreesport.com/>
14. Drug Story: http://www.drugstory.org/drug_info/performance.asp
15. MayoClinic.com <http://www.mayoclinic.com/health/drug-information/DrugHerblIndex>
16. That's Dope: <http://www.thatsdope.org/www.thatsdope.org>
17. Philen et al. JAMA 268:1008, 1992
18. Geyer et al. Int J Sp Med 25:124, 2004
19. Bents et al. Physician & Sports Medicine 32:30, 2004
20. Howe et al. Heat-Related Illness in Athletes. Am J Sports Med 35:1384, 2007
21. Leach RE. Editorial: Supplements. Am J Sports Med 27:275, 1999
22. Schwenk et al. When Food Becomes A Drug: Nonanabolic Nutritional Supplement Use in Athletes. Am J Sports Med 30:907, 2002
23. Tokish et al. Ergogenic Aids: A Review of Basic Science, Performance, Side Effects, and Status in Sports. Am J Sports Med 32:1543, 2004
24. Liam et al. Int J Sp Nutr & Exer Met, 2003
25. Kern et al. J Exer Phy, 2001
26. Branch et al. J Str & Cond Res, 2007
27. Groeneveld et al. Int J Sp Med, 2005