Athletic Performance

Genetic endowment

State of training

Nutrition
Definitions

Ergogenic

- Greek- work “generating”
- Performance-enhancing

Doping

- Boer- stimulating liquor
- Old English- opium mix
- Use of foreign agents, or physiological substances in excess quantities, to gain an unfair advantage in competition
Current Medicolegal Issues

Testing

“Natural” substances

Designer drugs
Current Medicolegal Issues

Role of the US Food and Drug Administration
How much power does it have to control availability of over-the-counter supplements?
Current Medicolegal Issues

1994 Dietary Supplement Health and Education Act
- Shifted responsibility away from manufacturers
- Eliminated FDA regulation of herbal “food products”
Current Regulation of Doping

Many national and international antidoping agencies

Individual regulating bodies often have differing provisions

In 1998 the IOC launched an initiative to standardize antidoping regulation

World Anti-Doping Agency (WADA) is established in 1999
World Anti-Doping Agency

Anti-Doping Code

Variations on this code are used by many contemporary sporting organizations
Supplements

Carbohydrates and Protein
Glutamine
Antioxidants
Creatine
Caffeine
Ginseng
Ephedrine Alkaloids
Carbohydrate and Protein Supplementation

Increasing lean body mass requires adequate energy and building blocks

Supplementation of adequate diet with protein, carbohydrate, or protein-carbohydrate combination increases lean body mass in over-reaching athletes

Dietary sources are preferable
Protein and Sports Drinks

Poor energy source; plays a role in recovery

Suggestion of adding protein to fluid and electrolyte recovery drinks

Attenuation of strength and power loss in overreaching resistance-trained athletes
Branched-Chain Amino Acid Supplementation

Dietary supplementation of 5-10 g/d prolongs exercise with minimal side effects

Theory:

- Prolonged exercise depletes glycogen
- Athlete metabolizes fat and (to some degree) protein
- Consumption of branched-chain amino acids yields excess tryptophan
- Tryptophan results in fatigue
Protein Supplementation in General

Increases in dietary protein likely to meet needs of most athletes

Unused excess carbohydrate and amino acids converted to fat
Glutamine Supplementation

Essential for lymphocyte proliferation

Used for repair of damaged myofibrils

Intense exercise depletes glutamine needed for lymphocytes
Glutamine Supplementation

May account for association of exhaustive exercise and susceptibility to illness

Controlled trials show reduced incidence of opportunistic viral infection in endurance athletes with 500 to 1000 mg/d
Antioxidant Supplementation

Mixed data
- Vitamin C
- Vitamin E
- Glutathione
- Beta-carotene

No evidence of performance improvement
At high doses, toxicity is a concern
Creatine

Maximize stores of phosphocreatine (ATP-PC system)

Short term: increased muscle creatine levels, increased lean body mass, increased weight lifting performance, explosive sprint
Creatine

Increased fluid increases muscle bulk

Added bulk may impair endurance

Anecdotal reports of increased rates of injury
Caffeine

Improves performance and endurance during prolonged exercise

Enhances short-term, high-intensity performance

Adenosine receptor antagonism; alters catecholamine release
  Positive physiological and psychological effects
Caffeine

Ergogenic at 5-10 mg/kg

No evidence of increased risk of heat injury or cardiovascular compromise (at these doses)

Insomnia, restlessness, anxiety
Ginseng

Shrub whose root is used as an ergogenic aid

Many varieties, and available in many forms (with poor quality control)

Failure to consistently demonstrate improvement in aerobic exercise

American ginseng may help prevent or decrease severity of colds
Ephedrine Alkaloids

May improve athletic performance (esp. when combined with caffeine)

In controlled studies, herbal ephedra ineffective on its own
Ephedrine Alkaloids

Associated with numerous Adverse Effect Reports
  AMI
  CVA
  Arrhythmia
  Heat illness

2001
  Ephedra products account for 1% of herbal supplement sales
  Account for 64% AERs
Ephedrine Alkaloids

FDA ban February 2004

May 14, 2007

US Supreme Court declines review of Nutraceutical Corp vs. von Eschenbach

Upholds ban
Ergogenic Aids

Anabolic steroids
Testosterone precursors
Peptide and Glycoprotein hormones
Human Growth Hormone
GHB
Erythropoietin and Synthetic Analogues
Anabolic (Tissue Building) Steroids

Mechanism of Action
- Prevent muscle breakdown
- Increase protein synthesis
- Increase release of growth hormone

Psychological

Scientific data studying efficacy of steroids remains controversial
Studies

Conflicting results
Limited population size
Different agents
Varying doses
Stacking/cycling

Differing skill levels of subjects: those who have reached plateau have greatest benefit
Anabolic Steroids

Do Increase:

Lean muscle mass
Strength

Do Not Increase:

Aerobic power
Aerobic capacity
Athleticism
Prevalence

Recent surveys suggest decline in anabolic steroid use

NCAA: 4.9% (1989) -> 1.4% (2001)

High School: 6-11% (1988-89) -> 3-5.4% (2002)
Prevalence

Initial use occurring earlier
  >40% first use in high school

Increased use among non-athletic males and females (2.9%)
Adverse Effects of Anabolic Steroids

Acne
Premature baldness
Gynecomastia
Altered cholesterol
Impaired glucose tolerance
Tendon strains and ruptures
Liver toxicity
Amenorrhea
Testicular atrophy/clitoral enlargement
Testosterone Precursors

Androstenedione, androstenediol, dehydroepiandrosterone

Higher doses at short term do raise testosterone

Side effect profile similar to anabolic steroids
Peptide and Glycoprotein Hormones

Human Growth Hormone (HGH)

Gamma Hydroxybutyric Acid (GHB)

Erythropoietin and Synthetic Analogues (EPO)
Human Growth Hormone

Produced in pituitary gland

Increases lean muscle mass

Medically useful to treat dwarfism
Human Growth Hormone

Produces skeletal muscle hypertrophy in mature adults

Potential ill effects
  Fluid retention
  Hyperlipidemia
  Acromegaly
Gamma Hydroxybutyric Acid (GHB)

Transiently stimulates release of growth hormone

Potent CNS depressant

Treatment of narcolepsy

Abuse as date-rape drug
Erythropoietin (EPO) and Synthetic Analogues

Produced by kidneys

Stimulates production of RBCs

Used for treatment of severe anemia secondary to systemic disease
Erythropoietin and Synthetic Analogues

Blood doping

Increased aerobic capacity for improved performance in endurance athletes
EPO Adverse Effects

Excessive RBC count

Dehydration may impair circulation
Risk of MI, CVA, CHF, arterial/venous thrombosis
The Future...

Designer drugs

New “natural” supplements

Genetic manipulation
www.usada.org

DRO- Drug Reference Online
Check if medication used is allowed by sport
Take Home Points

Many supplements can be as harmful as helpful.
Many supplements are unproven in scientific studies to provide the benefits that are advertised.
Supplements are an unregulated industry (no FDA oversight) and may contain substances that are not disclosed causing positive drug testing.
Check ingredients to see if the substance is allowed in competition.
References

Munro J. WADA code faces report criticism. BBC Sport, 9 April 2009.
References


