

Introduction to Ergogenic Aids



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Sports Supplement = **Ergogenic Aid**

Ergogenic is defined as, “tending to increase work”

An **ergogenic aid** is defined as



“A *physical, mechanical, nutritional, psychological, or pharmacological substance or treatment that either **directly improves physiological variables** associated with exercise performance or **removes subjective restraints** which may limit physiological capacity*”

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Examples of Ergogenic Aids?

- Swim suits
- Equipment – golf, cycling,
- Shoes
- Steroids
- EPO
- Diuretics
- Blood doping
- Caffeine
- Others???????

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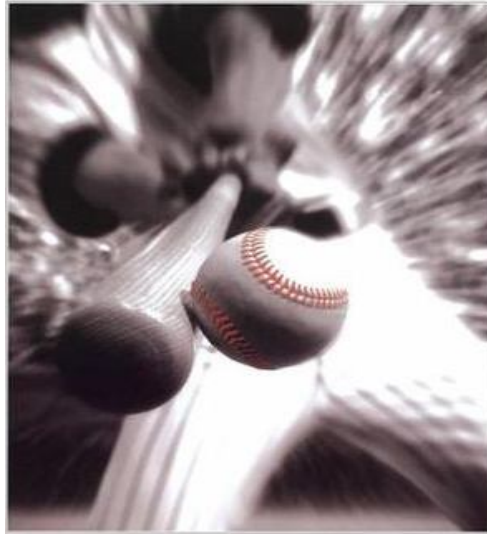
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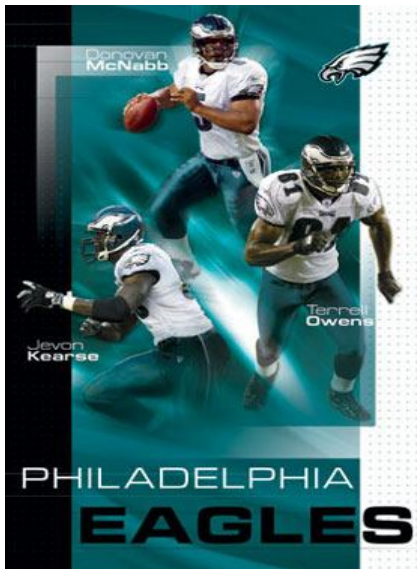
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What Are The Issues?



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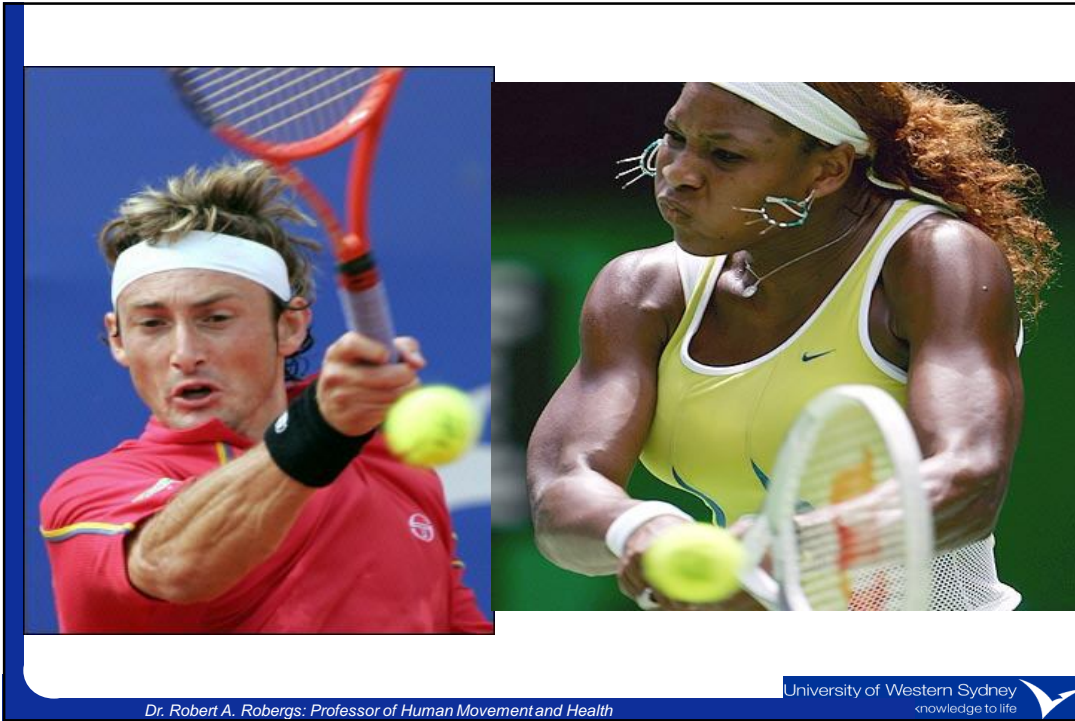
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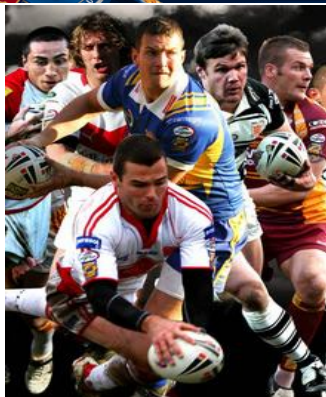
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More Than Just Sports & Athletics!



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Types of Ergogenic Aids

I. Mechanical

Running shoes, nasal breathing strips, equipment innovations, artificial turf, etc.

II. Pharmacological

Erythropoietin, β -blockers, antihistamines, growth hormone, anabolic-androgenic steroids, caffeine, amphetamines, ephedrine, β -hydroxy- β -methylbutyrate (HMB), Androstenedione, Dehydroepiandrosterone, etc.

III. Physiological

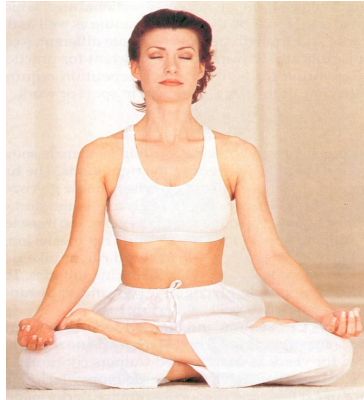
Blood doping, saline infusion, warm-up, clothing, etc.

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IV. Psychological

Hypnosis, psychotherapy, imagery, etc.



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V. Nutritional

A. Metabolic fuels

carbohydrate, protein, pyruvate, lactate, fat, caffeine, branched chain amino acids, etc.

B. Limiting cellular components

creatine, carnitine, vitamins, phosphate, NaHCO_3^- , etc.

C. Anabolic or stimulatory substances

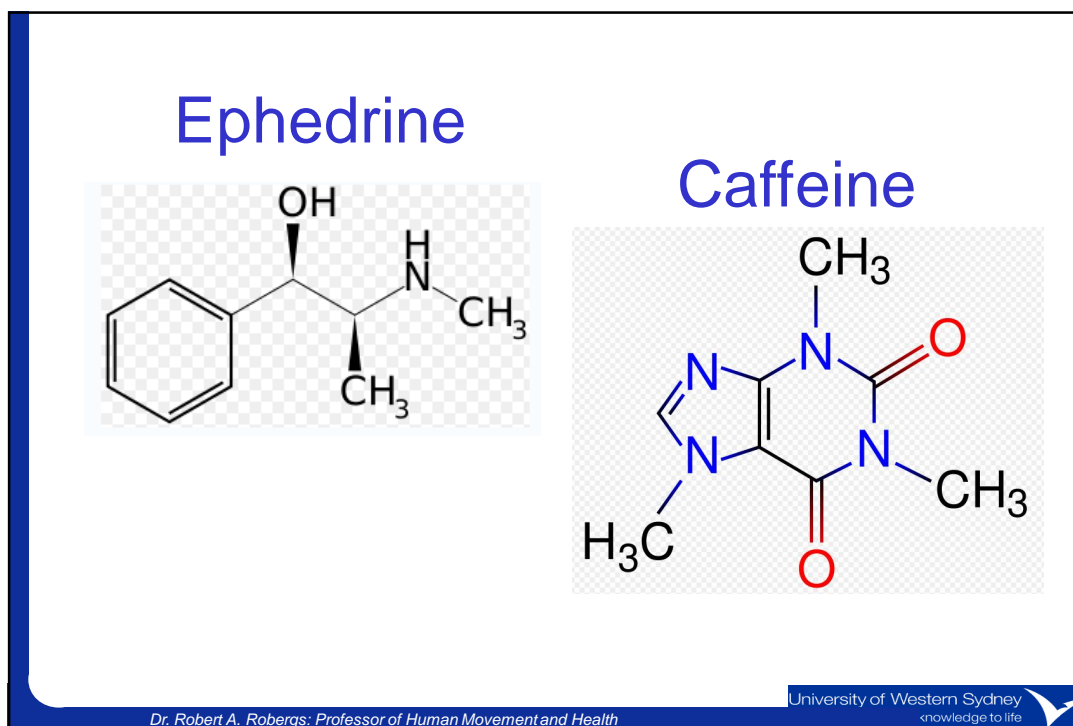
protein, chromium, vanadium, dichloroacetate, ephedrine, β -hydroxy- β -methylbutarate (HMB), Androstenedione, Dehydroepiandrosterone, caffeine, etc.

D. Anti-Catabolic

anti-oxidants, β -hydroxy- β -methylbutarate (HMB), etc.

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Caffeine

- ▶ The most highly consumed drug in North America and Europe.
- ▶ IOC initially banned caffeine in 1962, then removed from list in 1972.
- ▶ Today, urinary caffeine $> 12 \mu\text{g/L}$ is an IOC infringement. (*NCAA* $> 15 \mu\text{g/L}$)
- ▶ This urinary level requires $> 13.5 \text{ mg/kg}$ caffeine, where 1 cup coffee provides 80 mg.

IOC banned dosage

$$1012 \text{ mg}/80 = \mathbf{12.7 \text{ cups}}$$

Ergogenic benefit

$$330 \text{ mg}/80 = \mathbf{4.1 \text{ cups}}$$

Assumes 75 kg body mass

CAFFEINE

Improved exercise
endurance

↑ Diuresis

↑ Incidence of
cardiac arrhythmias

Stimulant to CNS

↑ Lipolysis

↓ Muscle glycogenolysis

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Androstenedione

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E. Substances that may enhance thermoregulation and/or prevent dehydration

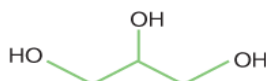
fluid, electrolytes, glycerol, sports drinks, etc.



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Glycerol



Ingestion of ~1.2 g glycerol/kg body mass with sufficient volumes of water (26 mL/kg) can induce an increase in hydration, termed **hyperhydration**.

Increased hydration can improve cardiovascular function and thermoregulation during conditions where dehydration is inevitable.



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Carnitine

Molecule that transports fatty acids into mitochondria. Research indicates that carnitine provides no ergogenic benefit.

Phosphate

Some evidence for increased VO_2 max and VT.

Sodium Bicarbonate

Increases blood bicarbonate and buffering potential. Increases performance during intense intermittent exercise.

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Creatine

- Most popular nutritional supplement on market @ \$300 million sales in U.S. in 2000.
- First reported supplementation – Barcelona Olympics 1992.
- Creatine is the main component of creatine phosphate. Creatine is found in meat and fish (mixed diet provides about 1 g/day), but is also synthesized in the liver, pancreas, & kidneys (1 g/day, which is suppressed with supplementation).

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Creatine

- Dietary supplementation of creatine of at least 15 - 25 g/day for 2-7 days can increase muscle creatine by 20 - 30%. (~ 20% is in CrP form)
- Physiological benefits inconsistently reported in research and changes are not large.
- Some detriment – increased body water (weight), muscle cramping, possible renal damage from long term high intake.
- Not banned, but in the U.S. the NCAA prevents college teams from providing it to players.

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Branched Chain Amino Acids

The main BCAA's are leucine, isoleucine and valine. These amino acids decrease the ability for **tryptophan** to cross the blood brain barrier, impeding the formation of **serotonin** and the **perception of fatigue** (central fatigue).



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Erythropoietin (EPO)

- A hormone that is mainly produced in the kidney in response to hypoxia, anemia, and blood loss.
- EPO stimulates increased red blood cell production (erythropoiesis).
- EPO also provides central nervous system stimulation
- EPO is widely used by elite endurance athletes, but has caused deaths due to organ damage resulting from excessive increases in blood viscosity.

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Blood Doping

- The removal of 1-4 units of blood, storage of the blood for 4-8 weeks, and the reinfusion of the red blood cells.
- Reinfusion usually occurs ~1 week prior to competition.
- Blood doping can double the [Hb], but typically this causes too much of an increase in blood viscosity.

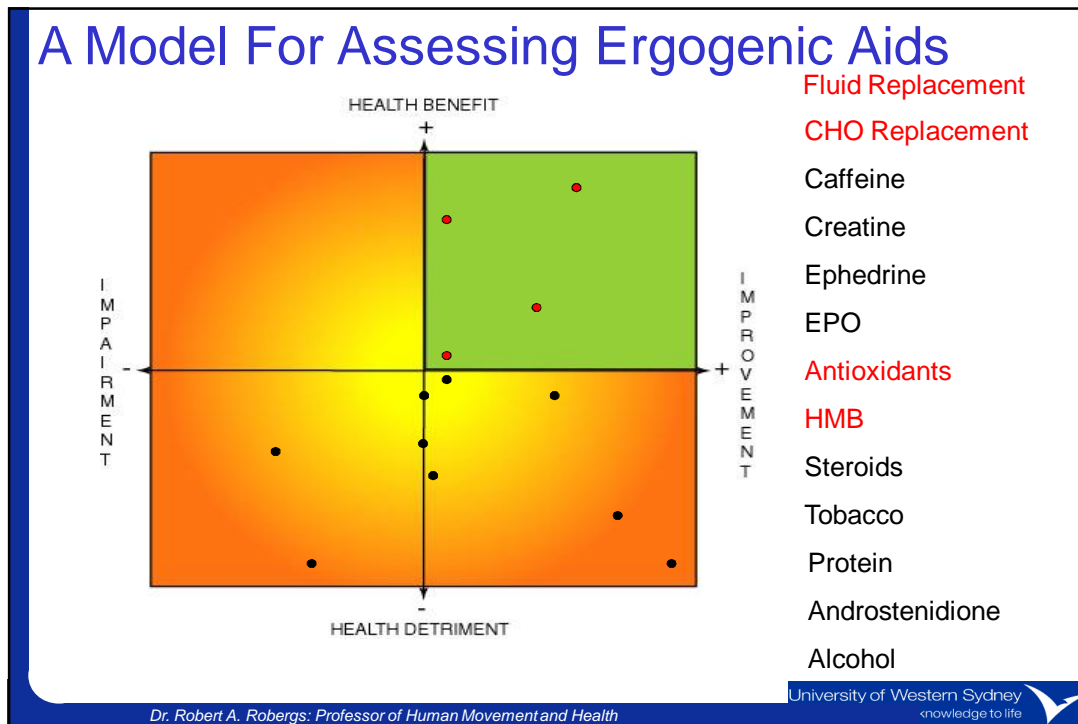
$$140 \text{ g/L} \times 1.34 \text{ mL/g} \times 0.98 = 148 \text{ mL/L}$$

$$200 \text{ g/L} \times 1.34 \text{ mL/L} \times 0.98 = 263 \text{ mL/L}$$

$$262 - 148 = \mathbf{79} \text{ mL/L}$$

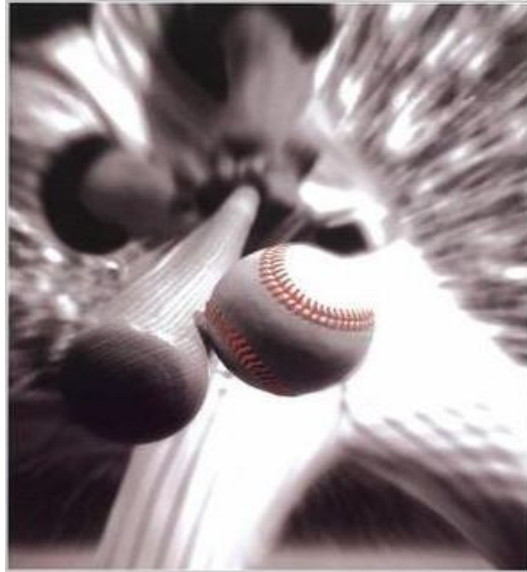
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- ## Conclusions
- Many forces are at work to promote supplement use and abuse.
 - Most nutritional ergogenic aids are unjustifiable.
 - Only positive choices are fluid, CHO and HMB.
 - Is steroid, or any ergogenic, abuse a symptom of a larger problem (*e.g: win at all costs*)?
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Thank You



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