

Chapter 13

Ergogenic Aids

Ergogenic

- Ergogenic
 - Having the ability to increase work (Taber's)
- Erogenic Aids
 - "In sports medicine, the questionable and often harmful use of various substances in an attempt to enhance performance." (Taber's)
- Performance Enhancing Drugs
 - Typically used to describe category of drugs that are banned for use in sports.

Chapter 13

- Noakes does not limit or focus in on illegal use of drugs to enhance performance.
- Covers topics from exercise to vitamins.

How much benefit can you expect?

- Depends on the initial level of fitness and performance.
- A small increase in performance (e.g., 1-1.5%) could be the difference in 1st place.
 - 100-m sprint 9.7 s → 9.6 s
 - Marathon 2 hr 10 min → 2 hr 8 min

Exercise Training

Anabolic Steroids and Other Banned Hormones

- Anabolic: Pertaining to the process of building up.
- Steroid: "An organic compound containing in its chemical nucleus the perhydrocyclopentanophenanthrene ring."
- Anabolic Steroid: Any group of (usually) synthetic hormones that are derivatives of testosterone.
 - Can be used medically to promote tissue growth.
 - Can be abused by athletes.
- Testosterone: A steroid sex hormone that is responsible for the growth and development of masculine characteristics.

Anabolic Steroids and Other Banned Hormones

- Banned
- Magnitude of effect can be large
 - Increase in power, speed, endurance, rate of recovery, ...
 - Table 13.1 ... expected benefits
- First used by power athletes
- Low doses may benefit endurance athletes
 - Suspicion of age-group athletes using

Increasing Oxygen Delivery

- Cardiovascular/Anaerobic Model predicts that superior endurance performance is achieved by enhancing oxygen delivery to muscles.
 - Increase cardiac output ($HR \times SV$)
 - Increase O_2 carrying capacity of blood
 - Increase capacity of muscle to extract and use O_2
 - Capillaries, mitochondrial volume, enzyme content

Increasing Oxygen Delivery

- Altitude
 - Live high, train low
 - Benefits of living at high altitude are attributed to lower available oxygen.
 - Increase in RBC
 - Disadvantage of training at high altitude is training speeds are slower (specificity).

Increasing Oxygen Delivery

- Blood doping
 - Technique used to increase RBC
 - Harvested RBC's are infused
 - Homologous: RBC's from athlete
 - Autologous: RBC's from compatible donor
 - Risks
 - Infection
 - Autologous: Transmitting disease
 - Potential toxicity of improperly stored blood
 - Thickening of blood; clot formation (chance of heart attack, stroke, pulmonary edema)
 - It works (Buick et al., 1980)
 - VO_{2max} tests 5 weeks apart
 - 2 groups: Blood Doping, Control (double blind)
 - 6% increase in VO_{2max}
 - 39% increase in endurance running time
 - Maintained for 7 days

Increasing Oxygen Delivery

- Erythropoietin (EPO)
 - Hormone
 - Produced naturally by the kidney
 - Stimulates RBC production
 - Synthetic EPO used to treat anemia
 - Sometimes aka blood doping
 - It works (e.g., Ekblom & Berglund, 1991)
 - Similar to blood doping improvements

Increasing Oxygen Delivery

- Using a high-altitude or nitrogen house
 - Breathing air with low levels of oxygen during sleep/rest for long periods of time.
 - Simulated altitude must be greater than 2500 m
- Training with oxygen-enriched air
 - Inhalation of air with increased oxygen percentage improves exercise capacity.
 - Noakes hypothesizes that increased oxygen to heart is what leads to increased performance (Central Governor Model).

Ergogenic Aids covered in other chapters

- Ingesting Carbohydrate to Prevent Hypoglycemia
- Preexercise Carbohydrate Loading
- Ingesting Fluid During Exercise
- Caffeine

Ergogenic Aids

- Sodium Bicarbonate or Sodium Citrate
 - Cardiovascular/Anaerobic Model predicts fatigue with anaerobic production of energy (byproduct = lactic acid)
 - Sodium Bicarbonate and Sodium Citrate buffer acids (i.e., lactic acid)
 - More buffering capacity should lead to avoiding fatigue
 - Ingestion of bicarbonate before high-intensity exercise of short duration produces an ergogenic effect.
 - Responders/non-responders ... not everyone sees a benefit
 - GI problems

Ergogenic Aids

- Preexercise Cooling
 - Benefit for activities lasting less than 30-minutes.
 - Central Governor Model: Thermostat

Ergogenic Aids

- Creatine Supplementation
 - ATP can be generated via the ATP-CP pathway
 - Creatine is produced in the liver
 - To increase phosphocreatine (PCr), you need to ingest high doses (20-25 g per day) of creatine for five days.
 - Average daily intake = ~1 g per day
 - Summary of research
 - No evidence of benefit during single burst of maximal exercise lasting less than 90 seconds.
 - Improves performance during repeated bouts of high intensity exercise (e.g., intervals)
 - Enhances adaptation to a weight training program
 - Endurance performance not influenced
 - The response to creatine supplementation is highly individual
 - No evidence of short- or long-term health risk

Ergogenic Aids

- Environmental Aids
 - Running surface
 - Lane choice
 - Clothing (wind resistance)
- Pacing
 - Optimal pacing strategy not determined

Summary

- Performance can be enhanced using several techniques / mechanisms
 - Banned substances
 - Anabolic steroids, blood doping, EPO, ...
 - Legal mechanisms / substances
 - Training, altitude, nutrition, surfaces, ...