**Daily Nutritional Requirements**

- Total daily energy requirement:
  - ~2000 kcal for women
  - ~3000 kcal for men

- Recommended nutrient intake:
  - **Protein**  
    0.83 g / kg body weight
  - **Lipid**  
    < 30% total kcal
  - **Carbohydrate**  
    50 – 60% kcal

  *Increased need for endurance athletes*

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**The Food Guide Pyramid**

- The essentials of good nutrition are displayed in this model
  - The model has been modified to guide modified diets
    *ex:*
    - **Mediterranean Diet Pyramid**
      - Protection against CHD
    - **Vegetarian Diet Pyramid**
      - Complete nutrition without meat / fish
Exercise and Food Intake

- Energy requirements vary depending upon the volume of training.
- Examples of events requiring increased energy intake:
  - Tour de France
  - Ultra-endurance running competition
  - Extreme ultra-endurance sports

Pre-competition Meal

- The ideal meal:
  1. Provides adequate carbohydrate
  2. Ensures optimal hydration
  3. Is well tolerated by the athlete
  4. Is easily digestible

- The meal should be consumed around 3 hours prior to competition

Protein or Carbohydrate?

- The evidence supports carbohydrate:
  1. Carbohydrate is the main energy nutrient
  2. Carbohydrates replenish liver and muscle glycogen
  3. Carbohydrate digestion and absorption are faster
  4. High-protein meals elevate resting metabolism
  5. Protein breakdown facilitates dehydration

How Much Should Be Consumed?

- Carbohydrates
  - 3 – 5 grams / kg body weight
  - 150 – 300 grams total
  - Solid or liquid form
  - Depends upon athlete’s preference and availability
  - Consume 3 hours prior to exercising
Carbohydrate Feedings

During prolonged high intensity exercise:
1. Spares muscle glycogen
2. Maintains more optimal blood glucose
3. Postpones fatigue
4. Improves endurance performance
5. Augments sprint capacity near the end of performance

Carbohydrate Feedings (cont.)

Prior to exercise
• Should be consumed between 1 and 3 hours prior to event to prevent rebound hypoglycemia

The glycemic index and pre-exercise feedings
• Fructose is absorbed more slowly than glucose
• If glucose is used, allow 1 hour for re-establishment of hormone levels

Liquid and Prepackaged Meals

Liquid meals are convenient

Other benefits of liquid meals:
• Provide some lipid and protein
• Provide fluid and high carbohydrate content
• Digest rapidly

Postexercise Meals

In recovery:
• Use moderate to high glycemic index foods
  – 50 – 75 g every 2 hours up to 500 g
• Keep lipid content low

Consuming food after exercise increases cellular uptake of glucose due to:
• Increased activity of GLUT 1 and GLUT 4
• Lowered catecholamine levels
• Increased activity of glycogen synthase

Glucose, Electrolytes, and Water Uptake

Glucose, water, and electrolytes are all important

Glucose and water influence one another’s uptake
• Large fluid volume may inhibit carbohydrate uptake
• Concentrated sugar solutions may impair fluid replacement
Gastric Emptying and Intestinal Absorption

- High fluid volumes speed gastric emptying
  - Consume 400 – 600 ml immediate pre-exercise
  - Ingest 150 – 200 ml every 15 minutes during exercise

- Carbonated beverages slow emptying

- Caffeine and alcohol promote diuresis

- Osmolarity
  - Particles in solution
  - Polymers may improve emptying rate

Fluid Replacement During Exercise

- Consume ~ 250 ml every 15 minutes
- Use a drink containing 5 – 8% carbohydrates
- Use a palatable drink to promote consumption

High-Fat Versus Low-Fat Diets

- High-fat diets may stimulate adaptive responses that enhance fat use
  - Controversial due to increased risks for CHD
- Research has not demonstrated benefits of a high-fat diet for improving endurance performance
- A high carbohydrate diet is still recommended over a high-fat diet

Ergogenic Aids

Pharmacologic Agents

- Commonly used herbal compounds:
  - Bee Pollen
  - Echinacea
  - Ephedra
  - Garlic
  - Ginseng
  - Ginkgo biloba
  - Yohimbe
Anabolic Steroids

- **Structure and action**
  - Sterol structure similar to testosterone
  - Promotes protein synthesis

- **Stacking**
  - Combining multiple steroid preparations in oral & injectable form

- **Pyramiding**
  - Progressively increasing the dosage

Anabolic Steroids (cont.)

- **Drug with a considerable following**
  - Its becoming increasingly popular with more than just strength athletes

- **Effectiveness**
  - Dosage is an important factor
  - Training volume accompanying use

- **Side effects and medical risks**
  - Cystic acne, “road rage,” peliosis hepatis, increased plasma lipoproteins
  - In males: testicular atrophy & gynecomastia
  - In females: clitoral enlargement, squaring of the jaw, lowering of voice

Androstenedione

- **Claims:**
  - Stimulates production of endogenous testosterone
  - Enables one to train harder
  - Increases muscle mass
  - Aids healing/recovery process

- Research shows no effect of supplementation on basal serum testosterone or any training response in terms of muscle size & strength

Growth Hormone

- **Genetic engineering comes to sports**

  - **Human growth hormone**
    - Produced in the Pituitary gland
    - Stimulates bone & cartilage growth
    - Enhances fatty acid oxidation
    - Reduces glucose & amino acid breakdown

  - **Excess GH may result in:**
    - Gigantism
    - Acromegaly

Amino Acid Supplements

- **Claims:**
  - Boost body’s natural production of:
    - Testosterone
    - Growth hormone
    - Insulin-like Growth Factor – 1

  - Resulting in an increase in muscle mass and a reduction in fat mass

  - Stimulating an anabolic effect:
    - Consuming carbohydrate and/or protein immediately after resistance training may augment hormonal response to the training
**Amphetamines**

- Stimulate the CNS = sympathomimetics

- **Claims:**
  - Increases alertness
  - Decreases sensation of fatigue

- **Dangers:**
  - Physiologic or emotional dependence
  - Headache, fever, dizziness, tremors
  - Suppression of normal responses to pain

- Use and athletic performance
  - Not ergogenic

**Caffeine**

- Ergogenic effects:
  - Proposed mechanism for ergogenic action
    - Increases use of fatty acids, sparing glycogen

- Effects on muscle
  - May act directly on muscle to enable more prolonged endurance performance

- Possible side effects:
  - Nervous irritability
  - Muscle twitching & psychomotor agitation
  - Elevated HR & blood pressure
  - Increased occurrence of PVCs

**Buffering Solutions**

- **Claims:**
  - Pre-exercise alkalosis facilitates H⁺ efflux from the cell, delaying the fall in pH
  - May be ergogenic for high-intensity endurance performance
  - Effect related to dosage and degree of anaerobic metabolism

**Nonpharmacologic Approaches**

- Red blood cell reinfusion—blood doping
  - **How it works**
    - Withdrawal of 1 – 4 units of blood
    - RBC are frozen
    - Re-infusion 1 – 7 days prior to competition
  - **Effects**
    - Increases RBC number, oxygen carrying capacity, and ability to perform endurance exercise
Hormonal Blood Boosting

- Erythropoietin (EPO)
  - Synthetic version of a hormone produced by the kidneys
  - May increase RBC number 12%
  - Unconventional or nonmedical administration may create a 66% increase
    ✓ Dangerous

Nonpharmacologic Approaches (cont.)

- Warm-up (preliminary exercise)
  - General warm-up
  - Sport-Specific warm-up
  - Psychologic considerations
  - Physiologic considerations
    ✓ Faster muscle contractions & relaxations
    ✓ Facilitated oxygen delivery – Bohr effect
    ✓ Facilitated nerve transmission & muscle metabolism
    ✓ Increased blood flow to active tissue
  - Effects on performance?
    ✓ Sudden strenuous exercise
      ✓ Risk of MI in sedentary or those with CHD

Modifying Carbohydrate Intake

- Carbohydrate loading
  - Helps prevent/postpone “Hitting the Wall” & glycogen depletion
  - Glycogen loading stage
    ✓ Glycogen super-compensation & tapering
  - Nutrient-related fatigue in prolonged exercise
    ✓ Carbohydrates are essential for performance

- Negative aspects:
  - Increased water retention
  - Added weight increases the energy cost of weight bearing exercise
  - Depletion phase may inhibit ability to train
  - Low carbohydrate intake may create ketosis

Creatine

- Supplement form - creatine monohydrate
  - Important component of high-energy phosphates
  - Documented benefits in humans
    ✓ Improved muscular strength and power
    ✓ Enables heavier lifting for greater overload
  - Creatine loading
    ✓ 20–25 g/day
    ✓ Some research shows no benefit

Ergogenic Aids

Moral & Ethical Dilemmas