Ergogenic Aids & The Athlete

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Ergogenic Aids

- Any substance or strategy that improves athletic performance by improving the production of energy.
- Derived from Greek words:
  - ergo (work) & gen (production of)
    - To increase potential for work output

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Ergogenic Aids

- Group 1
  - Performance-enhancing techniques
- Group 2
  - Performance-enhancing substances

http://www.nikehere.com/images/Nike-Free-3-0-(grey-green)-women-running-shoes-2.jpg

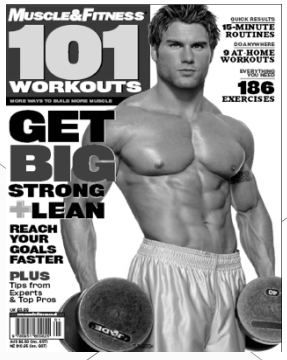
http://blog.standupandeat.org/image.axd?picture=energy+drink.jpg

Ergogenic Aids

PERFORMANCE-ENHANCING TECHNIQUES	EXAMPLE
Mechanical Aids - Mechanical, or biomechanical, aids designed to increase energy efficiency, to provide a mechanical edge.	**Lightweight racing shoes** may be used by a runner in place of heavier ones so that less energy is needed to move the legs and the economy of running increases.
Psychological Aids – designed to enhance psychological processes during sport performance, to increase mental strength.	**Hypnosis**, through posthypnotic suggestion, may help remove psychological barriers that may limit physiological performance capacity.
PERFORMANCE-ENHANCING SUBSTANCES	**EXAMPLE**
Physiological Aids – designed to augment natural physiological processes to increase physical power.	**Blood doping**, or the infusion of blood into an athlete, may increase oxygen transport capacity and thus increase aerobic endurance.
Pharmacological Aids – drugs designed to influence physiological or psychological processes to increase physical power, mental strength, or mechanical edge.	**Caffeine**, a commonly used drug, may increase physical power and mental strength to help improve performance in a variety of exercise tasks.
Nutritional Aids – nutrients designed to influence physiological or psychological processes to increase physical power, mental strength, or mechanical edge.	**Protein supplements** may be used by strength-trained athletes in attempts to increase muscle mass because protein is the major dietary constituent of muscle.

Dietary Supplements

- Dietary Supplements
  - Definition
  - Essential nutrients
  - Safe in recommended doses
- Sports Nutrition Supplements
  - Marketed to physically active individuals
  - Chemicals
  - Illnesses and death
  - False Labels



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Regulations

FDA

- Dietary Supplement Health and Education Act (DSHEA)
- Does not ensure the safety, effectiveness, or quality of dietary supplements.
- Supplement Facts label
- Health Claims vs. Therapeutic Claims
- FDA: "This product is not intended to diagnose, treat, cure, or prevent any disease."

National Collegiate Athletic Association (NCAA)

- Allowed
  - Providing non-ergogenic nutritional supplements
  - Essential nutrients
  - Food substances and constituents sold as dietary supplements.
- Prohibited
  - Providing ergogenic nutritional supplements
  - Many sports supplements (i.e. Androstenedione)
  - Dietary supplements that contain substances that are prohibited (i.e. Chinese ephedra).

Creatine

- Nitrogen-containing compound
- Supplemental creatine - Powder, pill, liquid forms and in protein bars
- Possible ergogenic effects
- Possible health risks
- Safe at recommended doses/not prohibited

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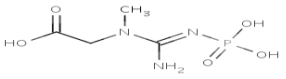
Creatine Biochemistry



- Creatine is naturally synthesized by the body as creatine phosphate
- Approximately 95% found in the skeletal muscles.
- 5% found in brain, liver, kidneys and testes
- Excreted as creatinine via urine.

Creatine Biochemistry cont.

- Creatine functions by controlling ATP and ADP ratios when skeletal muscle is intensely contracted.
  - Creatine phosphate donates a phosphate to ADP that forms ATP.
- Creatine monohydrate is supplemented to increase skeletal creatine levels.
  - Creatine monohydrate is a creatine complex with a single molecule of water.

Excess Consumption of Creatine Monohydrate

- Supplementation of up to 14 grams a day in healthy adults show no negative effects.
- Unhealthy adults
  - Pre-existing kidney dysfunction
  - Dehydration
  - Heatstroke
  - Muscle cramping
    - Leads to possible tendon rupture
  - Other ingredients in drink formulation?

Deficiencies of Creatine Monohydrate

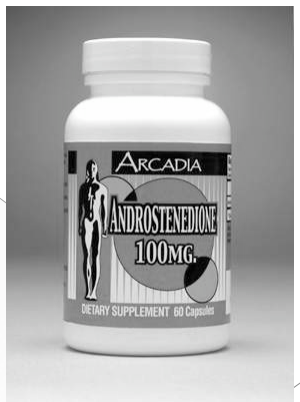
- Lack of intake of supplemental Creatine has no negative health impact
- Genetic disorders
  - Improper transformation and natural production
    - guanidinoeacetate methyltransferase (GMAT) disorder
    - arginine:glycine aminidotranferase (AGAT)
    - creatine transporter (CrT1) defect
      - Effects?

The Controversy - Creatine

- Creatine will increase lean mass?
  - Supplement vs. Weight training
- MuscleTech says: "Extra sugar in formulation will force creatine into muscle cells."
  - Who did the research?
- Belief systems

Anabolic/Androgenic Steroids (AAS)

- Definition
- Possible ergogenic effects
- Androgenic and estrogenic effects
- Risk of prostate cancer and cardiovascular disease
- Banned substance



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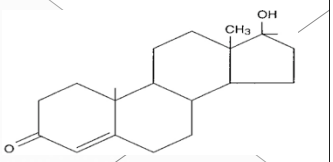
Anabolic Steroid Biochemistry

- Natural testosterone is mainly produced in the testes.
  - Small amounts are also produced in the ovaries and adrenal glands such as DHEA.
- In athletes, testosterone is responsible for increased lean muscle and bone density.



Anabolic Steroid Biochemistry (cont.)

- Anabolic steroids are properly known as Anabolic/Androgenic Steroids (AAS)
- AAS are synthetic forms of testosterone.
  - Testosterone is structurally altered to become more anabolic.
- AAS can be taken as a pill or injected in the buttocks, outer thighs, or shoulders.

Anabolic Steroid Biochemistry (cont.)

- AAS:
  - Increases anabolism, strength, and muscle growth.
  - Increases protein synthesis.
  - Increases the synthesis of creatine phosphate.
  - Increases body's nitrogen levels, setting a good environment for muscle growth.

Anabolic Steroid Biochemistry (cont.)

- Prohormones are a class of AAS that are taken by athletes.
- Prohormones are precursors to testosterone.
  - They are believed to increase testosterone levels in the body.
- There is no scientific determination on the efficacy of prohormones.

Excess usage of Anabolic/Androgenic Steroids (AAS)

- Any usage, prescribed or recreational, can have a negative health impact.
  - Minor to severe complications
- For athletes
  - What grows faster: Muscle or tendons?
  - Muscle
    - Can lead to tendon rupture

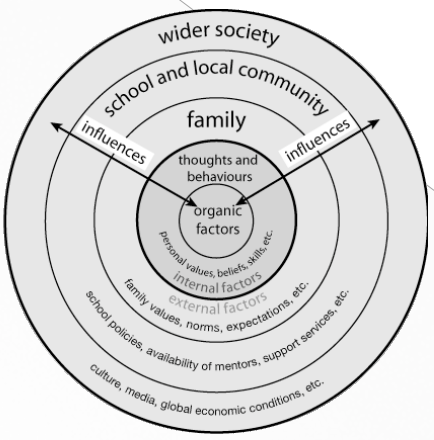
Deficiencies of AAS

- No effect of deficiencies if not taken SUPPLEMENTALLY.
- Natural deficiencies
  - Sarcopenia
    - Not normally seen in young adults
      - Anemia, Osteoporosis
      - Gonadal dysfunction

The Controversy - AAS

- Effects are well known, and usage is looked upon as cheating.
- Magazine Ads
  - Using the name of types of AAS with one or two letters added or taken away to make it look like the real thing.
    - Really it's just herbal supplementation to "increase testosterone."
  - Pictures of farm animals on labels?
- HBO: Real Sports with Bryant Gumbel

Human Ecological Theory



http://www.embracethefuture.org.au/resiliency/images/ecological-diagram.gif

- **Microsystem**
  - Income
  - Religious beliefs
  - Knowledge of the adverse effects of AAS
- **Exosystem**
  - Peers
  - Coaches
  - Friends
- **Macrosystem**
  - Media pressure
  - Educational programs

Research Articles

Ergogenic Aids & The Athlete

Effect of 28 days of creatine ingestion on muscle metabolism and performance of a simulated cycling road race

Hickner, R. C., Dyck, D. J., Sklar, J., Hatley, H., & Byrd, P. (2010). Effect of 28 days of creatine ingestion on muscle metabolism and performance of a simulated cycling road race. *Journal of the International Society of Sports Nutrition, 7*, 26.

Microsoft Office Clip Art

Effect of 28 days of creatine ingestion on muscle metabolism and performance of a simulated cycling road race

- Purpose
  - To measure the effects of endurance and performance in cyclists that ingest a creatine supplement for 28 days.

Effect of 28 days of creatine ingestion on muscle metabolism and performance of a simulated cycling road race

Methods

- 12 healthy male endurance trained athletes who participated in the study.
  - 6 participants received 3 g/day of creatine monohydrate for 28 days.
  - 6 participants were placed in the control placebo group.
- All 12 athletes participated in a 2-hour simulated cycling road race at 60% VO2 max.
  - Three 10 second sprints at 110% VO2 max was done every 15 minutes in the 2-hour race.
- Blood was drawn along with muscle biopsy during the 2 hours of exercise.

Effect of 28 days of creatine ingestion on muscle metabolism and performance of a simulated cycling road race

Results

- Creatine phosphate levels were elevated in the creatine supplementation group.
- There was no increase in plasma glucose or blood lactate in the creatine supplementation group.
- There was no increase in performance for the creatine supplementation group compared to the placebo group.

Effect of 28 days of creatine ingestion on muscle metabolism and performance of a simulated cycling road race

Conclusion

- There was no difference in performance between the creatine and placebo groups which could be due to:
  - Creatine is thought to be beneficial in short term, high resistance athletic output. Not a 2 hour aerobic output.
  - All participants were well trained, high endurance athletes where supplementation might not have made an impact on their endurance.

Effects of creatine supplementation on the performance and body composition of competitive swimmers

Mendes, R. R., Pires, I., Oliviera, A., & Tirapegui, J. (2004). Effects of creatine supplementation on the performance and body composition of competitive swimmers. *Journal of Nutritional Biochemistry*, 15, 473-478.

http://www.orangecoastcollege.edu/NR/rdonlyres/20C3E76D-C827-45A7-A26B-6CB28BAF3F23/2924/swimming2.JPG

Effects of creatine supplementation on the performance and body composition of competitive swimmers

Purpose

- To study the effects of creatine on swimming performance and swimmer's body composition.

Effects of creatine supplementation on the performance and body composition of competitive swimmers

Materials and Methods

- 18 competitive swimmers
  - 6 women; 12 men
- Double blind, placebo controlled
- Initial biochemical evaluations
  - Height, weight, age, body composition (lean mass and body fat)
- Supplementation for eight days
  - Treatment group: Five grams of creatine with 20 grams of CHO
  - Placebo group: 20 grams of CHO

Effects of creatine supplementation on the performance and body composition of competitive swimmers

Materials and Methods (cont.)

- Testing
  - Short high intensity
  - Long high intensity
  - Repetitive exercise with 30 second intervals
- 24-hour urine collection
- Serum creatine test
- Blood lactate test
- Final body composition measurments

Effects of creatine supplementation on the performance and body composition of competitive swimmers

Results

- Creatine had no effect on swimming performance.
- Body mass was increased
  - Muscle mass was not
    - What is it from?
- Increase in urinary excretion of creatine in creatine group.
  - 50% was stored during supplementation
  - A second increase in excretion after supplementation stopped.
- Increase in blood [lactate] in placebo group
  - ?

Effects of creatine supplementation on the performance and body composition of competitive swimmers

Conclusion

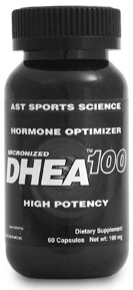
- Creatine monohydrate has no effect on swimming performance.
  - Does that mean it has no effect on weight lifting?
  - Showed increase in [lactate] in placebo
    - Creatine-monohydrate provides what for energy production?
      - ATP
  - Increase in body mass
    - Water retention

Effects of short-term dehydroepiandrosterone supplementation on body composition in young athletes

Ostojic, S. M., Calleja, J., & Jourkesh, M. (2010). Effects of short-term dehydroepiandrosterone supplementation on body composition in young athletes. *Chinese Journal of Physiology, 53*(1), 19-25.

Effects of short-term dehydroepiandrosterone supplementation on body composition in young athletes

- Dehydroepiandrosterone (DHEA)
- Possible effects
- Androgenic and estrogenic effects
- Health Claims



http://yolkedperformance.com/images/ast%20DHEA-100.jpg

Effects of short-term dehydroepiandrosterone supplementation on body composition in young athletes

- Purpose
  - Observe the effects of DHEA supplementation on body composition and serum steroid hormones in young soccer players.
- Methods
  - Twenty young elite soccer players
  - 19 to 22 years old
  - 100-mg daily oral DHEA supplementation
  - 28 day duration (4 weeks)
  - Treatment group vs. placebo group

Effects of short-term dehydroepiandrosterone supplementation on body composition in young athletes

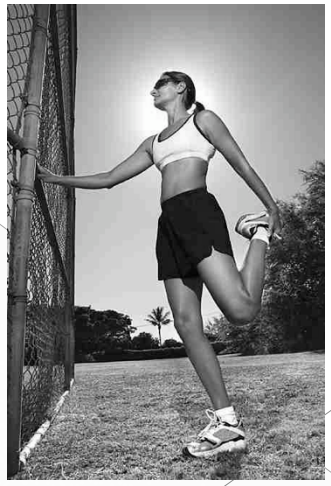
- Results
  - Body mass was not affected
  - No considerable changes in BMI, waist-to-hip ratio, body fat or total muscle mass in the treatment or placebo groups.
  - A significant increase in total testosterone, estradiol and DHEA-S in the treatment group vs. the placebo group.

Effects of short-term dehydroepiandrosterone supplementation on body composition in young athletes

- Conclusion
  - Does not induce changes in body composition.
  - Increases testosterone, estradiol and DHEA levels
  - Risks of possible prostate cancer or cardiovascular disease far outweigh the benefits.
  - DHEA supplementation is ineffective

The effects of growth hormone on body composition and physical performance in recreational athletes

- Meinhardt, U., Nelson, A. E., Hansen, J. L., Birzniece, V., Clifford, D., Leung, K. C., … Ho, K. K. (2010). The effects of growth hormone on body composition and physical performance in recreational athletes. *Annals of Internal Medicine, 152*, 568-577.



http://www.anemia.org/images/anemia/runner_stretching.jpg

The effects of growth hormone on body composition and physical performance in recreational athletes

Background

- Anabolic steroid & Growth hormone:
  ↓reduce body fat; ↑lean body mass; ↑ strength
- Combination:
  ↑improvement in body composition

Purpose

- Assess the effect of growth hormone and testosterone on body composition and physical performance in recreational athletes.

The effects of growth hormone on body composition and physical performance in recreational athletes

Methods

- Recreational athletes 18 - 40 years
  - Compete in state/national level
  - Positive results for prohibited agents
  - Had abused performance-enhancing drugs
- Randomly assigned to 4 groups for 8 weeks
  - Testosterone (250mg/wk)
  - Growth hormone (2mg/d)
  - Testosterone & Growth hormone
  - Placebo

The effects of growth hormone on body composition and physical performance in recreational athletes

Methods

- Body composition at Wk 0 & Wk 8
- Fat mass
- Lean body mass
- Extracellular water
- Body cell mass
- Physical Performance Tests Wk 0, Wk 8 & Wk16
- Endurance (Vo2 max)
- Strength (dead-lift test)
- Power (vertical jump height)
- Sprint capacity (30 sec sprint test)

The effects of growth hormone on body composition and physical performance in recreational athletes

	Fat mass (kg)	Lean body mass (kg)	Extra water mass (kg)	Body cell mass (kg)	Endurance	strength	power	Sprint capacity (kJ) At Wk 8	Sprint capacity (kJ) At 14 wk
Testosterone	×	+2.4	+1.2	+1.2	×	×	×	+0.9	+0.4
Growth Hormone	-0.5	+2.9	+2.4	+0.4	×	×	×	+1.1	+1.0
Combination	-1.0	+5.8	+3.6	+2.3	×	×	×	+1.7	+0.8

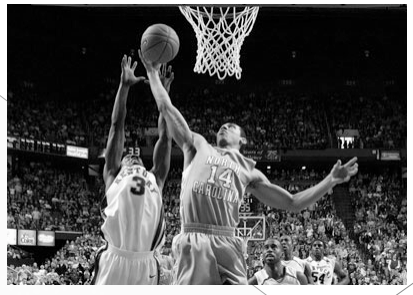
The effects of growth hormone on body composition and physical performance in recreational athletes

Conclusion

- Both GH and testosterone have the effect of changing body composition & increasing sprint capacities.
- When they are combined, the effects are greater.
- Improvement of sprint capacities were not maintained after a 6-week washout.

Prevalence and risk factors for anabolic-androgenic steroid abuse among Jordanian collegiate students and athletes

Tahtamouni, L. H., Mustafa, N. H., Alfaouri, A. A., Hassan, I. M., Abdalla, M. Y., Yasin, S. R. (2008). Prevalence and risk factors for anabolic-androgenic steroid abuse among Jordanian collegiate students and athletes. *European Journal of Public Health, 18*, 661–665.



http://images.forbes.com/media/2007/12/27/collegebball_01.jpg

Prevalence and risk factors for anabolic-androgenic steroid abuse among Jordanian collegiate students and athletes

Purpose

- Investigate the prevalence and risk factors for AAS abuse among Jordanian collegiate students and bodybuilders.

Methods

- 503 Collegiate students,154 Bodybuilders
- Self-reported questionnaire
- Demographic information
- Attitude towards the use of AAS
- Previous and current abuse of AAS & side effects

Prevalence and risk factors for anabolic-androgenic steroid abuse among Jordanian collegiate students and athletes

	Athletes		Collegiate student	
Response rate (%)	100		100	
Mean age (yrs)	28.1		19.9	
Current AAS user (%)	26		4.2	
	User	Nonuser	User	Nonuser
Monthly Income ($)	483.9	322.3	280.0	157.1
Major source of AAS	Coaches or friends		friends	
Main reason of using AAS	Improve performances		Improve appearances	

- 77% of the users consume more than one AAS at a time
- Health-related problems: increased appetite (37.7%), mood changes (36.1%), fluid retention (25%), headache (23%), increased hair growth (21.1%) and acne (21%)

Prevalence and risk factors for anabolic-androgenic steroid abuse among Jordanian collegiate students and athletes

Conclusion

- As a young country (90% population are <49 yrs), Jordan has a high prevalence of AAS abuse as much as developing countries.
- AAS has become a worldwide public concern, not only among athletes, but adolescent groups as well

Conclusion

- AAS and Creatine monohydrate minimally help athletes in improving their athletic performance.
- Greater risks than benefits
- AAS - Several detrimental effects including injury
- Creatine monohydrate – decreased muscle function
- 2010-2011 NCAA Banned Drugs

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Questions