

Hormones, Supplements, and Ergogenic Aids: Use and Abuse



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Introduction

- Supplements have been used since the early Olympic Games in order to enhance athletic performance and health
- Nowadays, the use of supplements is widespread as athletes are exposed to a great amount of information from coaches, peers, and the media

(Buell et al., 2013; Hughes, Shelton & Hughes, 2010)

The advertisement for T-Rex Muscle is a promotional graphic. On the left, a muscular man is shown from the waist up, holding a barbell. In the center is a bottle of T-Rex Muscle supplement, labeled 'MUSCLE MASS-BUILDER' and 'DIETARY SUPPLEMENT'. To the right of the bottle, a list of benefits is displayed: 'Lean Muscle Mass GROWTH', 'Shred Body Fat', 'Natural, Safe, Effective', 'No Negative Side Effects', and 'Free Up Testosterone'. Above this list are three circular seals: '100% SATISFACTION GUARANTEE', 'MONEY BACK GUARANTEE', and 'PRODUCT MADE IN THE UNITED STATES'. Below the benefits list is a yellow banner that says 'Claim your 30 day supply today'. At the bottom left, there are logos for 'NBC', 'FOX NEWS', and 'USA TODAY'. At the bottom right, there is a red banner that says 'TRY RISK FREE' with a white arrow pointing right. To the right of the product is a form titled 'TELL US WHERE TO SEND YOUR BOTTLE TODAY!' and 'YOUR SHIPPING INFORMATION'. The form includes fields for 'First Name:', 'Last Name:', 'Address:', 'City:', 'Country:' (with a dropdown menu set to 'United States'), 'State:' (with a dropdown menu set to 'Select State'), 'ZIP:', 'Phone:', and 'Email:'. Below the form are logos for 'VeriSign', 'VERIFIED by VISA', and 'McAfee SECURE'.

MUSCLE MASS BUILDER®
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<http://www.maletestosteronebooster.org/my-experience-with-t-rex-muscle/>

Introduction



- Ergogenic aids are very popular because they are marketed to improve athletic performance
- However, some athletes also resort to illegal aids such as anabolic steroids



Training practices and ergogenic aids used by male bodybuilders



HACKETT, JOHNSON, & CHOW (2013)

Article #1



- **Objective:**

- To determine whether training practices were in agreement with ACSM recommendations, if there were any significant changes to training based on place in season and finally the use of any drugs or supplements.

- **Methods:**

- Participants – 127 competitive males with ~7.5 years experience including 2 natural male world champions.
- Design – 24 question web-based survey to evaluate aid use and training practices.
- Analysis – number of sets/exercise, RM's used per set, recovery time between sets, aerobic training volume, quantity and type of ergogenic aid use.

Article #1



[http://forum.bodybuilding.com/showthread.php?
t=112926191](http://forum.bodybuilding.com/showthread.php?t=112926191)

What does the Research Say?



- **Results:**

- Split routines of 40-90 min. were used by all competitive bodybuilders once or twice per week.
- Training followed ACSM recommendations but varied depending on location in season
- AAS were used by 76.7% of respondents and dietary supplements were used by all.
- Supplements used were protein shakes, creatine, BCAA, glutamine, vitamins, fish oil, and ephedrine-containing/cafeine containing products.
- An average of ~3.6-3.3 steroidal agents were used during the OFF and PRE seasons respectively.
- Common nonsteroidal agents included clenbuterol, liothyromine, and clomifene.

What does the Research Suggest?



- **Discussion:**
 - Supplementation and drug use by bodybuilders is well known and confirmed by this study
 - Not surprising that protein, BCAA, and creatine are used
 - Dietary supplements pose less risk but also offer less performance improvement potential than AAS, abuse of which has been linked to severe physical harm
- **Limitations/Further Research:**
 - Focus on education and medical supervision since use is likely to continue
 - Need consistently updated testing procedures to find doping

Various Ergogenic Aids



- Blood doping
- Amphetamines and other stimulants (pre-workouts, caffeine, Illicit/prescription drugs)
- Blood buffers (beta alanine, carnosine)
- HMB
- Commonly used (creatine, glutamine, BCAA)
- Macronutrient supplementation (PRO, CHO, Fat)
- Antioxidants (vitamins A, C & E)
- Omega 3 fatty acids

Human growth hormone abuse in male weightlifters



**BRENNAN, B., KANAYAMA, G., HUDSON, J., &
POPE H. (2010)**

Article #2



- Objective:
 - To determine the prevalence of illicit HGH use within this athletic population, as well as any dependence on AASs and classical substances (cocaine, opioids, ecstasy) associated with HGH use.
- Methods:
 - Recruited in Florida, Massachusetts, and California
 - Used 231 experienced male weight lifters (ages 18-40)
 - Conducted a clinical interview to assess
 - ✦ Demographics, use of performance-enhancing drugs or classical drugs, dependence, fat-free mass index

What does the Research Say?



- Results
 - 43% used AASs at some point
 - 12% used HGH or IGF-1 at some point
 - ✦ 81% of these men diagnosed with either past AAS dependency or reported dependence on classical substances
 - Duration of use
 - ✦ AAS only: 24 weeks
 - ✦ HGH + AAS: 173 weeks
 - Fat-free mass index greater in HGH/IGF-1 users

What does the Research Suggest?



- **Discussion**

- HGH use is prevalent in the male bodybuilder population
- HGH does not produce a "high" but is associated with dependence on AAS and classical drugs
 - ✦ Perhaps visual results provide motivation to continue taking
- Future research needed to understand underlying neurobiology in HGH use

- **Limitations**

- Retrospective self-reporting
- Illicit substance use (purity and amount not certain)

Caffeine improves sprint-distance performance among division II collegiate swimmers



**VANATA, D. F., MAZZINO, N., BERGOSH, R., &
GRAHAM, P. (2014)**

Article #3



- **Background:**

- Caffeine is the most widely used drug globally
- CNS - increases attention, metabolic rate, alertness, reduces fatigue
- Antagonizes ADP to reduce fatigue and increase energy and arousal
- Widely used to increase athletic performance

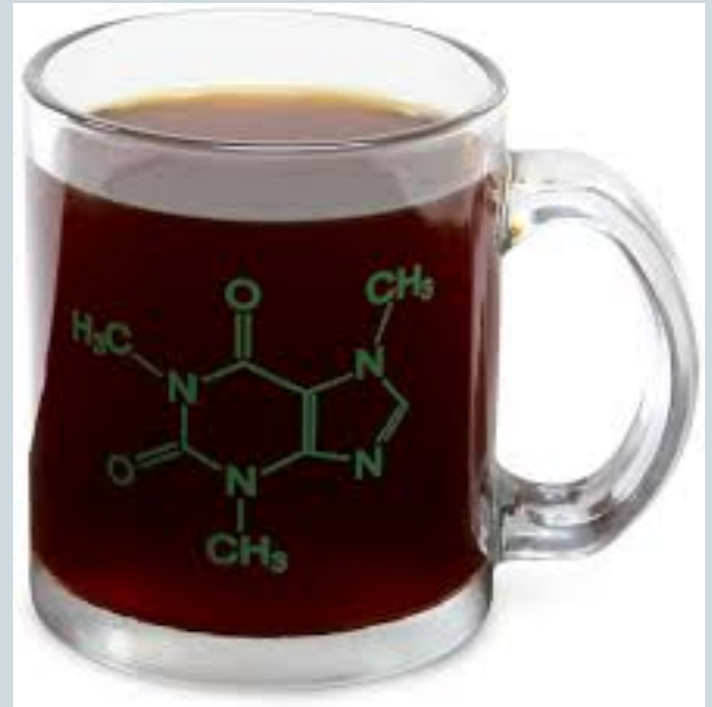
- **Objective:**

- To study the effects of caffeine supplementation of athletic performance during sprint-distance, high intensity time trial swimmers

Article #3



- **Methods:**
 - Single-blind crossover study design
 - Subjects: ($n = 30$) Division II collegiate swimmers
 - ✦ 43% female
 - ✦ 57% male
 - ✦ Mean age: 19.5
 - All subjects in-season swimming 6,000-8,000 yards per day.
 - Body weight of each subject used determine caffeine dose size



Article #3



- **Methods, cont...**
 - Subjects instructed to fast before each session
 - Subjects were randomly given treatment or placebo during first trial
 - Second trial subjects received opposite treatment
 - Treatment doses were specifically tailored to administer a dose of 3mg/kg
 - Peak absorption 30-60min
 - 50-yard time trials taken after warm up once, and again 8 days later
 - Urine sample collected and analyzed using High Performance Liquid Chromatograph(HPLC)

What does the Research Say?



- **Results:**
 - Perceived effects:
 - ✦ 37% classified as habitual caffeine users
 - ✦ 16% reported nerves/anxiousness after caffeine, 10% after placebo
 - Urinary caffeine analysis:
 - ✦ Significant difference in caffeine levels after ingestion of treatment vs. placebo
 - ✦ No significant difference between habitual caffeine users and non habitual users
 - Athletic performance:
 - ✦ Overall caffeine significantly improved 50-yard swim times
 - ✦ 70% of subjects showed improved times after caffeine ingestion
 - ✦ No significant difference in swim times between habitual/non habitual users
 - ✦ On average females improve .31 seconds, males .18 seconds

What does the Research Suggest?



- **Discussion:**

- Significant time improvements resulted after caffeine ingestion vs. the ingestion of a placebo.
- Fractions of a second are valuable for professional athletes — caffeine may affect outcomes
- Dosage fell within NCAA guidelines
- Habitual use may not affect physiological response to caffeine supplementation

Article #3



- **Limitations:**

- Although instructed to fast, subjects diets were not monitored (possible exposure to extra caffeine, etc.)
- Lifestyle factors including diet, sleep, other behavior
- Single-blind vs. double-blind
- Sample size

L-arginine supplementation and nitric oxide production: no additional effect when associated to exercise



**BAIAO, D., CONTE, C., SILVA, J.,
PASCHOALIN, V., & ALVARES, T. (2013)**

Article #4



- **Objective:**
 - To evaluate the effect of L-arginine supplementation on nitric oxide production in trained runners and investigate the possible changes in biochemical parameters of muscle fatigue

Article #4



- **Methods:**
 - 2 groups (L-arginine supplementation and placebo)
- Blood samples (cGMP, lactate, ammonia) were collected at baseline, immediately after exercise, and after 20 minutes of rest

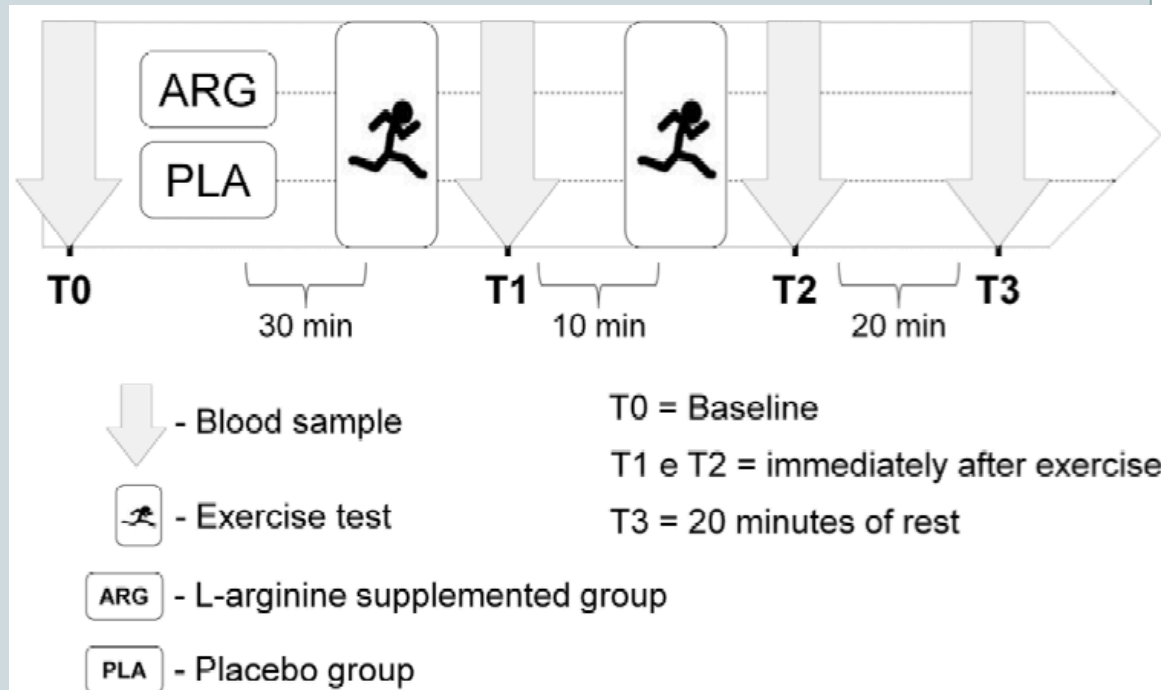


Figure 1. Experimental design of the study.

What does the Research Say?

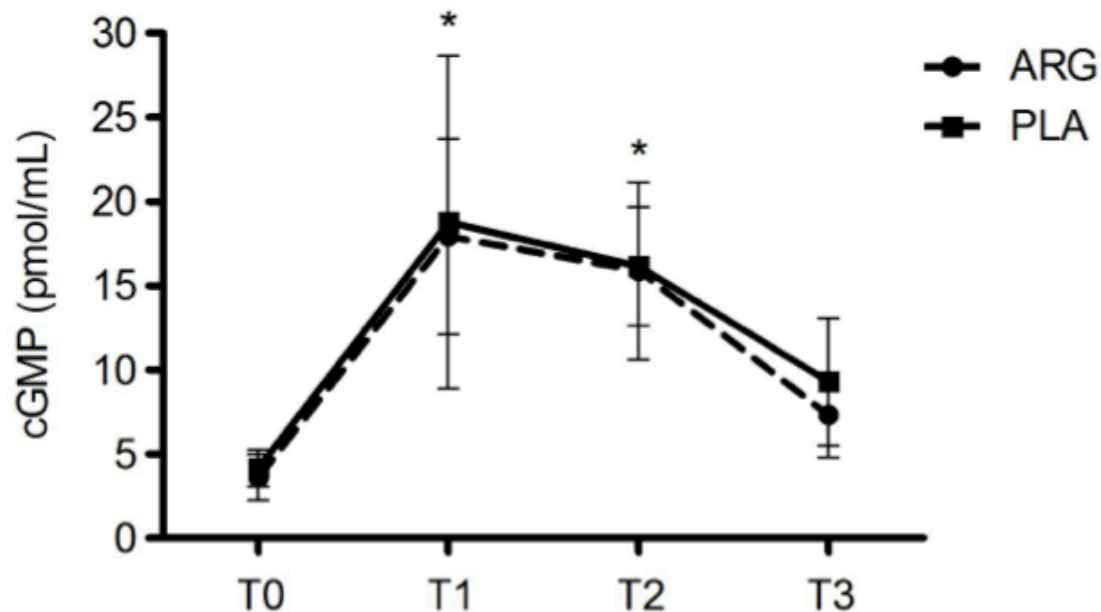


Figure 2. Plasma concentrations of guanosine monophosphate (cGMP) over the time points of the study. T0 = baseline; T1 = immediately after the first exercise test; T2 = immediately after the second exercise test; T3 = after 20 min of rest; ARG = L-arginine supplemented group; PLA = placebo group. The symbol * ($P < 0.01$) denotes significantly different from T0.

What does the Research Say?



- **Results:**

- Plasma cGMP concentrations increased significantly in response to exercise in both the supplement and placebo groups; however, there was no significant difference between the groups
 - ✦ There was no significant difference between the groups in plasma lactate and ammonia concentrations.

What did the research suggest?



- **Discussion:**

- Nutritional supplementation with L-arginine (6 g dosage) did not promote additional effects on NO synthesis when associated with running exercise
 - ✦ Furthermore, the supplementation did not reduce the accumulation of plasma lactate and ammonia
 - ✦ L-arginine should not be recommended as an ergogenic aid to improve NO production in healthy athletes

- **Limitations**

- Sample size

The use of energy drinks, dietary supplements, and prescription medications by United States college students to enhance athletic performance



**HOYTE, C. O., ALBERT, D., & HEARD, K. J.
(2013)**

Article #5



- **Objective:**
 - To determine the proportion of college students who report using energy drinks, dietary supplements, or prescription medications to enhance athletic performance
- **Background:**
 - Energy drink/supplement manufacturers not required to receive FDA approval
 - Energy drink-related emergencies go from 1,128(2005) to 13,114(2009)
 - Estimated 30-50% of adolescents use energy drinks/dietary supplements

Article #5



- **Methods:**

- Design: cross sectional college survey program (RADARS - Researched Abuse, Diversion, and Addiction-Related Surveillance)
 - ✦ Subjects: 2-year, 4-year, online or technical school students (at least 18 or older)
- From all over United States
- Anonymous online survey with screening questions designed to eliminate respondents who lack relevant data
- Demographic questions, behavior regarding energy drinks, supplements, sports, drugs, alcohol

What does the Research Say?



- **Results:**

- Of college students who responded (n = 1960), 23.6% (n=462) were active participants in sports
- Male (n = 276, 59.7%) female (n = 186, 40.3%)
- 397 (85.9%) reported using energy drinks, dietary supplements, or medications in the last year to enhance performance, (energy drinks - 80.1%, dietary supplements - 64.1%, and prescriptions - 53.3%)
- Use of performance enhancing substances was highest among semiprofessional athletes(93.8%), then followed by intercollegiate (89.4%)
- Swimmers, football players and basketball players had highest usages, soccer players the lowest

What does the Research Suggest?



- **Discussion:**

- Performance enhancing substance use may be more common than previously thought - research needed to examine the possible additive health risks of complications from substance interactions and use
- Supplements use is common — risk of supplements difficult to determine
- Perceived benefit of enduring sleep deprivation/pressure to perform may influence stimulant use
- Further research should assess whether use of these substances increases likelihood of use of anabolic steroids of growth hormones.

Article #5



- **Limitations:**
 - Data reliant on honest accurate responses (self-reporting)
 - Internal validity
 - Voluntary responders decreases external validity - students who choose to respond
 - May be fundamentally different than students who do not.
 - Clear definition of substances discussed (i.e. “supplements,” “prescription drugs”)

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