

Safety and Efficacy of Vitamins and Supplements: The Athlete/Active Adult

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Objectives

- ▶ Review the current evidence behind commonly used ergogenics, which are supplements and food products used to enhance athletic performance
- ▶ Discuss how to consider and evaluate vitamins and supplements in terms of both their risk, safety and efficacy, and help our patients do the same
- ▶ Highlight that competitive athletes must consider banned substances when deciding to use any OTC supplement or supplement food due to adulteration risk in these products

Our Case: Sylvester

- ▶ Sylvester is a 29 yr old male who is about to start shooting his first motion picture where he will play an amateur boxer. He is asking what supplements may aid in getting him “bulked up” a little faster than diet and training alone and you could recommend some “safe” ones.



<https://people.com/movies/sylvester-stallone-claims-zero-ownership-rocky/>

Ergogenic Aids

- ▶ Substances marketed and used to optimize physical performance, efficiency and recovery
- ▶ Most sports “foods” are made up of amino acids, creatine and/or caffeine
- ▶ As of 2016 they made up 13.8% of the \$41 billion supplement industry (over a \$5B share of this market)
- ▶ Prevalence of use among athletes ranges from 10-100%
- ▶ Men turn to proteins and creatine, women to iron
- ▶ The data on them is conflicting; most studies are designed for and inform only conditioned athletes, with a goal of assessing safety and potential for aiding performance, usually for only a single ingredient (which is rarely sold on its own)

Considerations when evaluating vitamins and supplements

- ▶ All vitamins and supplements are sold without pre-marketing FDA approval and are essentially regulated identically as foods per the 1994 Dietary Supplement Health and Education Act
- ▶ The DSHEA assumes supplements are generally regarded as safe
- ▶ Puts the onus of safety on the manufacturer
- ▶ States the product “may not claim to diagnose, mitigate, treat, cure, or prevent a specific disease”
- ▶ Label must state every ingredient, and if a proprietary blend used, the total amount of the blend contained in the product
- ▶ At the time the law was written there were approximately 600 supplement manufacturers in the US—now there are 1,400; the supplement market was valued at \$4B; it is now \$39B

Considerations when evaluating vitamins and supplements

- ▶ No one is able to guarantee the safety of any supplement due to the fact that these products are not tested for safety, purity or evaluated for accuracy in labeling (and many studies have shown the majority of these products are either mislabeled or adulterated or inconsistently produced)
- ▶ Looking for 3rd party verification of a product (NSF, USP) is a way to have fair confidence that what is on the product label reflects what is in the package
- ▶ A product that says “proprietary blend” is essentially making itself impossible to test/verify and is best to avoid
- ▶ Some products, especially herbs, need to be standardized, and certain parts of the plant need to be used for the desired effect to be achieved; herbs also contain other excipient substances such as caffeine whose content will not be reflected on the label

This is your go-to Resource!

<https://ods.od.nih.gov/>



Strengthening Knowledge and
Understanding of Dietary Supplements

Health Information

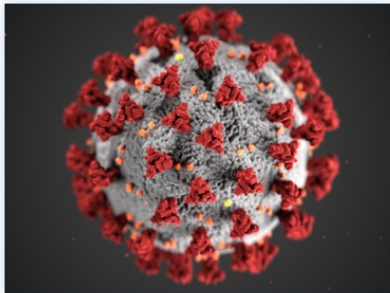
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About ODS

Featured Fact Sheets



COVID-19

Data do not support the use of dietary supplements for COVID-19.



Carnitine

Animal products such as meat, fish, poultry, and milk are the best sources of carnitine.



Multivitamin/minerals

MVMs contain a combination of vitamins and minerals.



All Fact Sheets (A-Z)

Fact sheets on dietary supplements and their ingredients.

<https://ods.od.nih.gov/factsheets/list-all/>

Dietary Supplement Fact Sheets

This collection of fact sheets and other resources from the NIH Office of Dietary Supplements and other federal government sources presents information about dietary supplements and their ingredients. These include vitamins, minerals, herbs and botanicals, probiotics, and more. Many of these resources are available in versions written for consumers (in both English and Spanish) and also for health professionals.

[5](#) [A](#) [B](#) [C](#) [D](#) [E](#) [F](#) [G](#) [H](#) [I](#) [K](#) [L](#) [M](#) [N](#) [O](#) [P](#) [Q](#) [R](#) [S](#) [T](#) [V](#) [W](#) [Y](#) [Z](#)

5

- [5-HTP \(5-hydroxytryptophan\)](#)

A

- [Acai](#)
- [Activated charcoal](#)
- African mango (see [Weight Loss](#))
- [Alfalfa](#)
- [Aloe vera](#)
- [Alzheimer's disease](#)
- [Anabolic steroids](#)
- Andrographis (see [COVID-19](#))
- Antioxidants (see [Exercise and Athletic Performance](#))
- [Apple cider vinegar](#)
- Arginine (see [Exercise and Athletic Performance](#))
- [Ashwagandha](#)

General Supplement Information

- [Dietary Supplements: Background Information](#)
- [Botanical Dietary Supplements: Background Information](#)
- [Vitamin and Mineral Fact Sheets](#)
- [Botanical Supplement Fact Sheets](#)
- [Frequently Asked Questions](#)
- [Dietary Supplements: What You Need to Know](#)
- [ODS Videos](#)
- [Información en español](#)


Supplements for Specific Purposes

- [COVID-19](#)
- [Alzheimer's disease](#)
- [Brain Health](#)
- [Diabetes](#)
- [Exercise and Athletic Performance](#)
- [Eye conditions](#)
- [Menopause](#)
- [Osteoarthritis](#)
- [Primary Mitochondrial Disorders](#)



Top

Supplements for
athletes or the
active adult with
good or
reasonable
evidence

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Nitrates

- ▶ Nitrates increase endogenous production of nitric oxide which improves both O₂ delivery and waste removal in tissue via its vasodilation effects
- ▶ Studies have shown 4-25% increase to time to exhaustion (improves endurance), increased efficiency of mitochondrial respiration, reduced ATP cost of muscle energy production
- ▶ Studied ergogenics include:
 - ▶ L-arginine-converted to NO and precursor of creatine synthesis
 - ▶ may increase hGH secretion
 - ▶ GI side effects at high doses
 - ▶ No safety data for use longer than 3 mos
 - ▶ Citrulline-converted into arginine
 - ▶ Beetroot juice/powder
- ▶ Data thus far suggests it is better simply to have good fruit and veggie intake for above adequate nitrate intake (studies typically use doses (2-20mg/day) that are lower than those found in normal diet)



Amino Acids

- ▶ 9 essential, and 3 of these are branched chain amino acids (BCAAs)
- ▶ Data is limited/conflicting on utility of non-branched and non-essential AA supplementation as ergogenic aid
- ▶ BCAAs (leucine, isoleucine, valine) are metabolized by mitochondria for immediate energy
- ▶ Benefits of BCAAs include:
 - ▶ Increased muscle mass -PMID: 28638350
 - ▶ Decreased muscle soreness -PMID: 20601741
 - ▶ Reduce exercise fatigue thru their attenuation of serotonin production, the neurotransmitter signal for exercise fatigue -PMID: [27418883](#), PMID: [29755574](#)
- ▶ Up to 20g/d of BCAAs safe
- ▶ Their benefits are only realized if there are also adequate amounts of ALL EAAs as well
- ▶ Whey protein contains all EAAs and significant amounts of leucine→most commonly used in commercially available protein powders and has been shown to increase muscle hypertrophy, strength and power -PMID: 25169440



Creatine

Good for strength/power but not endurance

Our liver and kidneys make about 1g/day, and this is stored mostly in muscle

It is the most studied ergogenic (usually in the form of creatine monohydrate)

Once metabolized into creatinine, it is excreted in urine

Helps generate ATP for short-term (anaerobic) energy

Typical use: loading dose of 20g/day x 7d then 3-5 g/d

Increases both strength and power in as little as 5-7 d of use

Vegetarians have lower [creatinine muscle] and may get bigger benefit from its use

Short term use is regarded as safe

Side effects: water retention/weight gain

Caffeine

- ▶ Binds to the adenosine receptor to block fatigue/tiredness signal, increases endorphin release
- ▶ Seems to aid in both endurance and sprint activities
- ▶ Peak effect noted 45min post consumption ($t_{1/2}$ about 5 hrs, varies based on habituation)
- ▶ No data showing habitual use decreases performance
- ▶ 2 deaths reported after use of powdered caffeine
- ▶ Doses of 2-6mg/kg pre-exercise studied
 - ▶ Can decrease pain and perceived exertion
 - ▶ May help mobilize free fatty acids for energy
 - ▶ Increases performance vary from 0.7-17% in studies
 - ▶ ACSM states it decreases perceived fatigue, increases time of sustained intensity
 - ▶ >500mg/day may *decrease* performance
 - ▶ NCAA rules- [urine] cannot exceed 15 mcg/ml (achieved at doses of 500mg)

Our Case

- ▶ Sylvester says he currently has a pretty clean diet, and will time his coffee intake differently armed with this new information, but he also is considering adding eggs to his diet to help with muscle mass and strength and asks if this is a decent idea



Protein

- ▶ Data suggests athletes need more protein per kg body weight than non athletes (Food and Nutrition Board rec's 1.2-2kg/d for athletes compared to 0.8kg/d in nonathletes, 1.0kg/d in teens, 1.5kg/d in kids)
- ▶ ACSM: Optimal time of protein consumption in 0-2hrs post-exercise in amount of 0.3g/kg body weight, then q 3-5hrs to maximize amino acid uptake into myofibers; this increased uptake is called the “anabolic window” and is present to some degree in the 24 hrs post-exercise
- ▶ Upper limit of protein intake that can be successfully incorporated into muscle building at once has not been determined in studies PMID: [29497353](#)
- ▶ Side effects: very low risk of over-ingestion in those without kidney disease; GI side effects most common

Protein

- ▶ A few studies promote qhs protein intake to increase overnight muscle building
- ▶ Considerations:
 - ▶ Heme protein is better absorbed than non-heme protein
 - ▶ Only heme proteins and soy are complete proteins (contain all 9 essential Aas)
 - ▶ These complete proteins are about 40% EAAs and 60% non EAA's
 - ▶ Increased intake of soy protein is not associated with increase risk of estrogen-sensitive cancers and has actually been shown to *reduce* this risk

Supplements with Little to No Data

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Free Radical Scavengers

The use of vitamin C, E and Co-Q 10 in athletes have been shown to possibly blunt the effect of exercise in increasing mitochondria and myofiber growth by blunting the effect of free radicals on the tissues which stimulate these changes

Most doses studied well below the tolerable upper daily limit (UL) recommended

Safe but ineffective and maybe even counterproductive!

Iron

- ▶ Aids in O₂ delivery in both Hgb and myoglobin
- ▶ May be the most commonly used supplement vitamin in sports despite lack of data
- ▶ Exercise can increase loss due to sweat and due to less gut absorption of iron
- ▶ Widely accepted use is to treat iron deficiency with anemia in female athletes
- ▶ Unclear if use in iron deficiency without anemia improves performance
- ▶ ACSM recommends it only if true iron deficiency is present
- ▶ UL/day is 40mg/day for women, 45mg/day for men
- ▶ Using higher doses can lead to side effects (GI, fainting)
- ▶ Excellent review article about iron use in female athletes :
DellaValle, Diane M. PhD, RD. Iron Supplementation for Female Athletes: Effects on Iron Status and Performance Outcomes. Current Sports Medicine Reports 12(4):p 234-239, July/August 2013. | DOI: 10.1249/JSR.0b013e31829a6f6b

Energy Drinks

Often used as a surrogate caffeine delivery system

Many drinks contain higher doses of caffeine than labeled due to natural caffeine in the herbs added to these products

Overdose of caffeine can lead to cardiovascular effects, seizure, psychosis

Less considered side effect: obesity (also a sugar delivery system)

While OTC medicines have a 200mg/dose caffeine limit, energy drinks have no limit

ACSM says approach these products with caution and limit use in kids

- ▶ Anabolic steroids (for obvious reasons)
- ▶ DHEA
 - ▶ Banned by WADA/NCAA
 - ▶ Precursor to testosterone/estrodinol
 - ▶ No data on increased strength, lean body mass, testosterone levels
- ▶ Deer antler velvet
 - ▶ Banned by WADA/NCAA
 - ▶ Theoretically contains IGF-1 but often adulterated, often found to have no IGF-1

Ergogenics to
Avoid

Advising Athletes and Active Adults on Supplement Use

- ▶ Up to 59% of athletes use supplements in the US
- ▶ Competitive athletes need to realize the risk that many are banned by WADA or NCAA
- ▶ All supplements run the risk of adulteration with dangerous (lead) or banned (growth factors, hormones) substances
- ▶ It is hard to find consistent data on supplement use in exercise due to how ergogenics are produced (usually in a proprietary blend or with multiple sports foods in the formulation) and the many outcomes that can be evaluated across all sports
- ▶ Any supplement or vitamin must have low risk and potential benefit to justify its use in the general public and for an athlete should have data showing it will not hurt performance

Sources

- ▶ <https://ods.od.nih.gov/factsheets/ExerciseAndAthleticPerformance-HealthProfessional/>
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- ▶ https://journals.lww.com/acsm-csmr/Fulltext/2018/02000/Energy_Drinks___A_Contemporary_Issues_Paper.9.aspx
- ▶ Schoenfeld et al. How much protein can the body use in a single meal for muscle-building? Implications for daily protein distribution. PMID: [29497353](https://pubmed.ncbi.nlm.nih.gov/29497353/)
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- ▶ https://ods.od.nih.gov/About/DSHEA_Wording.aspx
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