

Does Vitamin D Mimic the Effect of Anabolic Steroids?

Analysis by [Dr. Joseph Mercola](#)

April 26, 2025

STORY AT-A-GLANCE

- › Vitamin D influences key hormones like leptin, an energy balancer, and myostatin, which limits muscle growth. It plays a direct role in how your body manages energy, builds muscle and regulates fat storage through various metabolic pathways
- › A study published as a preprint on Research Square found that high-dose vitamin D increases muscle strength, reduces myostatin, shifts calories toward muscle development and enhances metabolic rate
- › Vitamin D mimics anabolic steroids by suppressing myostatin to optimize muscle growth, redirecting energy from fat storage to muscle tissue and boosting metabolic rate
- › Optimal vitamin D levels for health and disease prevention range from 60 to 80 ng/mL (150 to 200 nmol/L). Test twice a year and adjust your supplemental dose based on your results
- › Natural sunlight is the ideal vitamin D source, as it provides benefits beyond vitamin D production. However, make sure to reduce your consumption of vegetable oil before sun exposure

For years, calorie storage was thought to be a simple equation – consume more than you burn, and the excess is stored as fat. However, emerging research shows that energy balance is far more complex. Your body's ability to store or burn calories is not just about how much you eat, but also how hormones regulate the process. This system determines whether energy is directed toward fat accumulation or muscle maintenance.

At the center of this regulation are two key hormones – leptin, which helps control hunger and fat storage, and myostatin, which suppresses muscle growth. Researchers from The Children's Hospital of Philadelphia and The University of Pennsylvania Perelman School of Medicine have found that vitamin D influences both of these hormones, suggesting it plays a direct role in how your body manages energy and builds muscle.¹

Interestingly, researcher Georgi Dinkov, who is a student of the late Ray Peat, a biologist, thyroid expert and pioneer in prometabolic therapy and human metabolism, has drawn a compelling connection between vitamin D and anabolic androgenic steroids. He suggests that vitamin D influences muscle growth and fat metabolism in ways that closely resemble the effects of steroids, but without the dangerous consequences.²

How Anabolic Androgenic Steroids Work and Why They're Risky

Before diving into the role of vitamin D, it's important to understand how anabolic steroids work. These synthetic compounds have been widely used to speed up muscle growth and reduce fat by altering hormone signaling, particularly through testosterone and related androgens.³ In his blog,⁴ Dinkov explains the primary mechanisms of anabolic steroids, which include:

- **Suppressing myostatin** – Myostatin is a protein that restricts muscle growth. Anabolic steroids lower myostatin, allowing for uncontrolled muscle growth.
- **Increasing protein synthesis** – Steroids enhance nitrogen retention, making it easier for muscles to synthesize new protein and grow faster.
- **Repartitioning calories toward muscle instead of fat** – By altering hormonal balance, steroids push excess energy into muscle-building rather than fat storage.
- **Raising metabolic rate** – Increased lean muscle mass boosts resting metabolic rate (RMR), leading to greater calorie burn and reduced fat accumulation.

While these effects contribute to rapid muscle growth, they come with severe risks, such as:

- **Hormonal disruption with long-term consequences** — Anabolic steroids flood the body with synthetic androgens, overriding natural hormone production. Over time, this suppresses testosterone levels, leading to testicular shrinkage, infertility and dependence on external hormone therapy.⁵
- **Liver and cardiovascular damage** — Prolonged steroid use increases the risk of liver toxicity, high blood pressure and heart disease. The artificial boost in muscle mass comes with elevated cholesterol levels, arterial plaque buildup and increased risk of heart attacks.⁶
- **Psychological effects and addiction** — Steroids alter dopamine and serotonin levels, leading to mood swings, aggression ("roid rage"), anxiety and depression. Many users develop dependency, requiring continuous cycles of steroids just to maintain their physique.^{7,8,9}

The pursuit of muscle growth and fat loss should not come at the expense of your long-term health — this is where vitamin D comes in.

How Vitamin D Influences Muscle Growth and Fat Storage

You probably know vitamin D as the "sunshine vitamin" that keeps your bones strong, but its role in the body extends far beyond bone health. The featured study, published as a preprint on Research Square in May 2024, highlights how vitamin D serves as a key nutrient signal that helps regulate energy availability and distribution throughout the body.¹⁰

- **Vitamin D acts as a nutrient sensor** — The body detects vitamin D levels as a signal of nutrient availability, influencing how it allocates energy between fat storage, muscle growth and metabolic function. Vitamin D exerts these effects primarily through activation of the vitamin D receptor (VDR), which has been shown to influence both fat metabolism and muscle regulation.

- **Vitamin D influences leptin production and sensitivity** – White fat, which serves as your body's primary storage for excess energy, produces the majority of circulating leptin, a hormone involved in energy balance and metabolism. Studies in VDR knockout mice (which lack functional vitamin D receptors) show that without vitamin D signaling, white fat is nearly absent, leading to persistently low leptin levels.
- **Vitamin D is vital for muscle function** – Deficiency in vitamin D has long been associated with muscle weakness, and replenishment has been shown to restore strength and improve muscle performance. While prior research has largely focused on vitamin D deficiency, new findings suggest that even within normal vitamin D levels, increasing intake provides additional benefits to muscle strength and function.
- **Muscle and fat mass are closely linked** – Scientists have traditionally studied fat metabolism and muscle regulation separately, but evidence now shows that the two are deeply interconnected.

When muscle mass increases, total body weight and fat mass often increase as well. On the other hand, excessive weight loss, particularly a loss of more than 10% of baseline weight, triggers muscle mass loss in proportion to fat loss. Dinkov expanded on this, stating:

"Based on this information, a logical conclusion is that (paradoxically) the key to weight loss is muscle gain, which will then lead to fat loss over time. In other words, the goal should be body repartitioning – exchanging fat for muscle – not simply blind weight loss, which decimates muscle mass."¹¹

- **Vitamin D regulates energy balance through myostatin and leptin** – Muscle-specific loss of vitamin D signaling leads to an increase in myostatin. At the same time, conventional VDR knockout mice exhibit very low serum leptin levels, reinforcing the idea that vitamin D signaling plays a direct role in regulating both muscle mass and fat metabolism.

Learn more about the importance of vitamin D to your physical and mental health in "[The Crucial Role of Vitamin D in Physical and Mental Health](#)."

Can Vitamin D Work Like Anabolic Steroids?

In the featured study, researchers conducted experiments to determine how different levels of vitamin D influence muscle strength, calorie allocation, hormone regulation, energy expenditure and growth. They divided mice into three groups based on their vitamin D intake – no vitamin D (0 IU/kg), normal vitamin D (2,000 IU/kg) and high vitamin D (10,000 IU/kg). After measuring vitamin D's direct effects on body composition and metabolism, they observed several key outcomes:^{12,13}

- **Vitamin D enhances muscle strength** – After supplementation, mice given high-dose vitamin D showed significantly greater grip strength than those receiving normal or no vitamin D. These strength gains were dose-dependent, with high-dose vitamin D producing the greatest improvements.

Just as steroids increase muscle strength by stimulating protein synthesis and muscle function, vitamin D enhanced strength independent of dietary protein intake or exercise levels.

- **Vitamin D suppresses myostatin to optimize muscle growth** – The study found that raising vitamin D from low to normal significantly reduced myostatin, allowing for greater muscle development. Even though raising vitamin D from normal to high did not further lower myostatin, muscle mass per unit of body weight still increased, suggesting that vitamin D suppresses myostatin activity within muscle tissue itself.
- **Vitamin D shifts calorie allocation toward muscle** – One of the hallmark effects of anabolic steroids is their ability to redirect excess energy away from fat storage and toward muscle growth.

The study confirmed that high-dose vitamin D produces this same effect, increasing lean muscle mass while decreasing fat mass without altering total body weight.

Instead of simply increasing overall weight, calories were actively redirected to support lean tissue development.

- **Vitamin D enhances fat metabolism** – Mice that received low levels of vitamin D had poor leptin signaling, leading to inefficient fat metabolism and increased fat storage. When vitamin D was increased from low to normal, leptin production improved, and when increased from normal to high, leptin sensitivity increased without affecting leptin levels.

This mimics how anabolic steroids enhance fat metabolism, particularly through their effects on insulin and cortisol. ^{14,15}

- **Vitamin D boosts metabolic rate naturally** – Like anabolic steroids, which increase resting metabolic rate (RMR) due to greater muscle mass, high-dose vitamin D increased energy expenditure even though food intake and activity levels remained the same. This metabolic boost happened without artificial hormone manipulation, showing that vitamin D acts as a natural metabolic enhancer rather than disrupting endocrine function like steroids.
- **Vitamin D stimulates skeletal growth like anabolic steroids** – One of the anabolic effects of steroids is their impact on bone density and height growth.

The study found that high-dose vitamin D increased height in mice, and a genetic analysis confirmed that individuals with higher vitamin D levels tend to have greater final height. Additionally, high-dose vitamin D increased skeletal growth in zebrafish, supporting the idea that vitamin D functions as a natural growth enhancer across species.

These findings confirm that high-dose vitamin D mimics key effects of anabolic steroids, all without the severe risks associated with steroid use.

Sunlight Is Best for Optimizing Your Vitamin D Levels

While vitamin D supplements are an effective way to maintain adequate levels, natural sunlight remains the ideal method for optimizing vitamin D production. The benefits

commonly linked to vitamin D are actually a reflection of healthy sun exposure, with higher vitamin D levels serving as a marker of sufficient sunlight exposure rather than the primary driver of health benefits.

- **Sunlight provides benefits beyond vitamin D production** – Exposure to ultraviolet (UV) radiation triggers numerous biological processes, including nitric oxide release for improved circulation,¹⁶ immune system modulation and mitochondrial support.¹⁷ These effects work synergistically with vitamin D, making direct sun exposure the ideal source.
- **Dietary seed oils compromise safe sun exposure** – One of the most overlooked risks of UV exposure is its interaction with **linoleic acid** (LA), the primary polyunsaturated fat (PUF) found in seed oils and processed foods. When UV radiation interacts with LA in the skin, it triggers inflammatory responses and DNA damage, increasing the risk of photoaging and skin cancer.
- **Limiting sun exposure is necessary if vegetable oils are still in your diet** – People who consume high amounts of vegetable oils should be cautious with sun exposure, as their skin is more prone to oxidative stress and inflammation. A safer approach is to limit direct sun exposure to early morning or late afternoon until seed oils are eliminated from the diet for at least four to six months.
- **Skin pigmentation affects vitamin D synthesis** – Melanin acts as a natural sunscreen, meaning individuals with darker skin require longer sun exposure to produce the same levels of vitamin D as those with lighter skin. This factor needs to be considered when determining safe and effective sun exposure times.
- **Body fat stores and prolongs oxidative risk** – Since fat tissue stores fat-soluble compounds, individuals with higher body fat percentages are at greater risk of prolonged exposure to oxidized vegetable oils, even after dietary changes. This means those with higher body fat should be more cautious with sun exposure, as stored LA continues fueling inflammatory responses long after seed oils are removed from the diet.

Safe Sun Exposure Guidelines

A reliable method for determining appropriate sun exposure is the "sunburn test." Monitor your skin for any redness – staying below the threshold where your skin shows even slight pinkness indicates you're within safe exposure limits. Avoiding sunburn is important, as it signals UV-induced damage and increases long-term risks.

- **Sunburn risk decreases as your body clears stored seed oils** – As your body reduces its LA stores, your susceptibility to sunburn and skin cancer declines. However, for the first six months after eliminating seed oils, it's best to avoid direct sunlight during peak UV hours – two to three hours before and after solar noon.
- **Full clearance of stored seed oils takes approximately two years** – While the six-month mark allows for safer peak-hour sun exposure, complete clearance of oxidized seed oils from tissue takes closer to two years. Until then, cautious sun exposure remains important.
- **Peak sunlight hours vary with the season** – During Daylight Saving Time, solar noon occurs at 1 p.m. instead of 12 p.m., meaning peak sunlight hours fall between 10 a.m. and 4 p.m. Understanding this helps in planning safe exposure times to minimize UV damage.
- **Protective strategies for safer sun exposure** – If you plan to spend time in the sun before your body has fully cleared stored vegetable oils, consider the following natural sun protection strategies:
 - Take 12 milligrams (mg) of astaxanthin daily to enhance your skin's UV resistance and reduce oxidative damage.
 - Apply topical niacinamide (vitamin B3) cream before sun exposure to protect against UV-induced DNA damage.
 - Take a baby aspirin (81 mg) 30 to 60 minutes before sun exposure to help prevent LA conversion into harmful oxidized linoleic acid metabolites (OXLAMs).

- Use molecular hydrogen supplements to combat oxidative stress and reduce inflammation caused by UV exposure.

To fully understand how sunlight influences your overall health and how to safely optimize your exposure, read "[The Role of Sun Exposure in Optimizing Your Cellular Health](#)."

Tips for Vitamin D Supplementation

When regular sun exposure isn't feasible, vitamin D supplementation becomes necessary to achieve and maintain optimal levels. This is especially important for individuals living in northern climates or those who spend most of their time indoors, as natural sunlight remains the most effective source of vitamin D.

- **Vitamin D3 is superior to Vitamin D2** — Your body naturally synthesizes vitamin D3 when exposed to ultraviolet B (UVB) rays from sunlight. In contrast, vitamin D2 is derived from plant sources like yeast and mushrooms exposed to UV light. While both forms are available as supplements, research confirms that vitamin D3 is significantly more effective at raising blood vitamin D levels.

For a deeper look at how these vitamin D forms compare and which one your body absorbs best, check out "[What's the Difference Between Vitamin D, D2 and D3?](#)"

- **Testing ensures proper supplementation** — Since vitamin D needs vary based on sun exposure, body composition and genetic factors, testing levels regularly is essential to ensure adequate intake. The conventional threshold for deficiency (below 20 ng/mL) is far too low, and research suggests that true sufficiency starts at 40 ng/mL (100 nmol/L), with optimal health benefits appearing between 60 and 80 ng/mL (150 to 200 nmol/L).
- **Follow these steps to optimize vitamin D levels** — To maintain sufficient levels, supplementation should be adjusted based on individual test results:
 - Test your vitamin D levels twice a year to track seasonal fluctuations.

- Modify sun exposure or supplementation depending on your test results to maintain sufficiency.
- Perform follow-up testing after three to four months to assess changes and adjust dosage accordingly.
- Continue regular monitoring to ensure vitamin D levels remain within the optimal range (60 to 80 ng/mL).
- **Higher doses may be required for full metabolic benefits** – While conventional guidelines aim to prevent deficiency, research suggests that higher doses of vitamin D may be required to unlock its full metabolic benefits.

According to Dinkov, the standard 2,000 IU daily recommendation falls short for anything beyond basic sufficiency. For optimal metabolic support, he argues that intake levels should be significantly higher – closer to 10,000 IU per day.¹⁸

Frequently Asked Questions (FAQs) About Vitamin D and Energy Balance

Q: How does vitamin D support muscle growth?

A: Vitamin D helps reduce myostatin, a protein that limits muscle growth. It also improves strength, enhances protein synthesis and helps your body use calories for muscle instead of fat storage.

Q: Can vitamin D help burn fat?

A: Yes, vitamin D plays a role in fat metabolism by regulating leptin, the hormone that controls appetite and fat storage. It helps your body burn fat more efficiently and supports a healthy metabolism.

Q: Does vitamin D have effects similar to steroids?

A: Vitamin D influences muscle growth and fat loss in ways that resemble anabolic steroids, but naturally. Unlike steroids, vitamin D doesn't disrupt hormone levels or cause dangerous side effects.

Q: What's the best way to boost vitamin D naturally?

A: Getting regular sun exposure is the best way to raise vitamin D levels. If that's not possible, take vitamin D3 supplements.

Q: How much vitamin D should you take daily?

A: Optimal intake depends on your blood levels. Testing your vitamin D levels is the best way to determine your ideal dose. Aim for 60 to 80 ng/mL for optimal health.

Sources and References

- ^{1, 10, 12} Res Sq [Preprint]. 2024 May 8:rs.3.rs-4202165
- ^{2, 4, 11, 13, 18} Haidut.me December 8, 2024
- ³ StatPearls [Internet]. Anabolic Steroids
- ⁵ Science Direct, Anabolic Steroid
- ^{6, 7} NIDA, Anabolic Steroids and Other Appearance and Performance Enhancing Drugs
- ⁸ Drug and Alcohol Dependence Volume 231, 1 February 2022, 109275
- ⁹ Psychopharmacology (Berl). 2021 Mar 20;238(7):1911–1922
- ¹⁴ Sports Med Open. 2024 Mar 27;10:28
- ¹⁵ J Nutr Metab. 2011 Jul 28;2011:237932
- ¹⁶ Scientific Reports volume 13, Article number: 16306 (2023)
- ¹⁷ Cureus. 2023 May 5;15(5):e38578