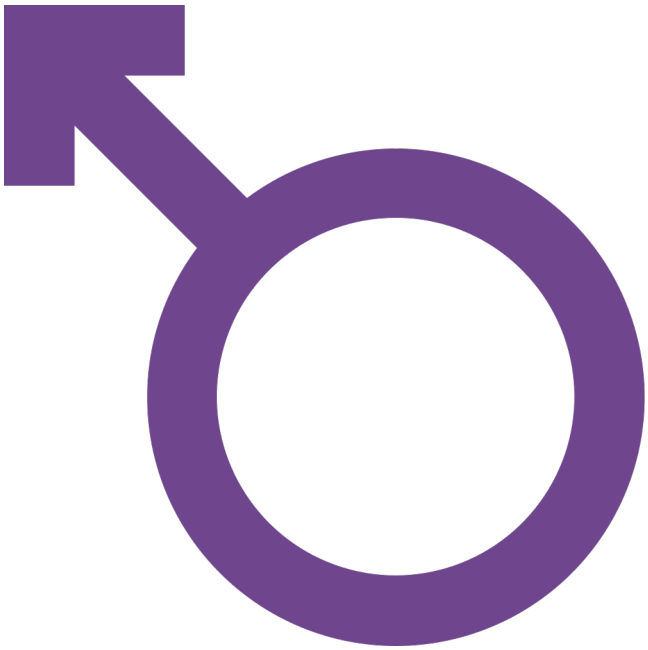
Examine®

# Testosterone Supplement Guide



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# Introduction

Not many people are aware of the role testosterone plays in female libido, mood, muscle gain,[1] and fat loss, so few women ever think about their levels. Conversely, some men are obsessed with their testosterone levels — stressing out if their numbers are "below average" or if successive blood tests show the smallest drop.

Although putting too much stock in numbers is a mistake, for reasons we shall review, guys are right to care about their *testosterone* (T). Studies have shown that *testosterone replacement therapy* (TRT) can improve cognition, mood, libido, muscle mass, bone mineral density, and the production of red blood cells, with the only notable downside being an uncertain (but probably null[2][3][4]) effect on prostate cancer.[5]

> 🔍 **Digging Deeper: Testosterone and your prostate**
>
> Testosterone was artificially synthesized for the first time in 1935. Soon after, it started to be used as a potential therapy in clinical trials, with promising results. And then came some bad news: In the early 1940s, a link between testosterone and prostate cancer was established (i.e., the "androgen hypothesis"). One of the researchers even went on to win the Nobel Prize for discovering connections between hormones and cancer.
>
> For several decades, this finding cast a pall on the therapeutic use of T. But the most recent evidence suggests that the androgen hypothesis is misleading: high testosterone levels don't seem to cause prostate cancer; rather, very low testosterone levels allow prostate cancer to regress (which is why drugs that drastically lower T levels are frequently given to men with prostate cancer).
>
> This new hypothesis is called the "saturation model"[6]: maximal stimulation of prostate cancer happens at a relatively low T level, so moderate-to-high T levels may not have much of an additive effect. Of course, medical science is rarely conclusive and never simple, so make sure to speak to your physician about testosterone and medical conditions.

In the eyes of men, testosterone is the Holy Grail of hormones, and like the Grail, it is shrouded in mystery. But taking the time to understand the concepts below gives a better idea of where T fits into the big picture of fitness. That understanding in turn allows better targeting of efforts to optimize T levels.

# Low testosterone can hide behind many symptoms

If a person is feeling crappy in general, their physician will likely want to check their levels of the thyroid hormones TSH, T4, and T3; vitamin-D; and, if the person is a man, testosterone.

That's because testosterone plays a central role in wellness and vitality. In men, low T is notably linked to inflammation, weight gain, and cardiovascular issues.[7] For the almost 40% of men over age 45 who have low T,[8] this is bad news.

But what do low T levels mean? Are the person's levels naturally lower than average? Is it normal, age-related decline? Or is there something wrong with the body? If so, what is the culprit — or, more likely,

culprits? We'll mention possible answers, but first, what are normal ranges?[9]

The T levels of American men seem to have decreased over the past few decades, for both total T and free T.[10] Total T is all the testosterone floating around in the blood and has three components:

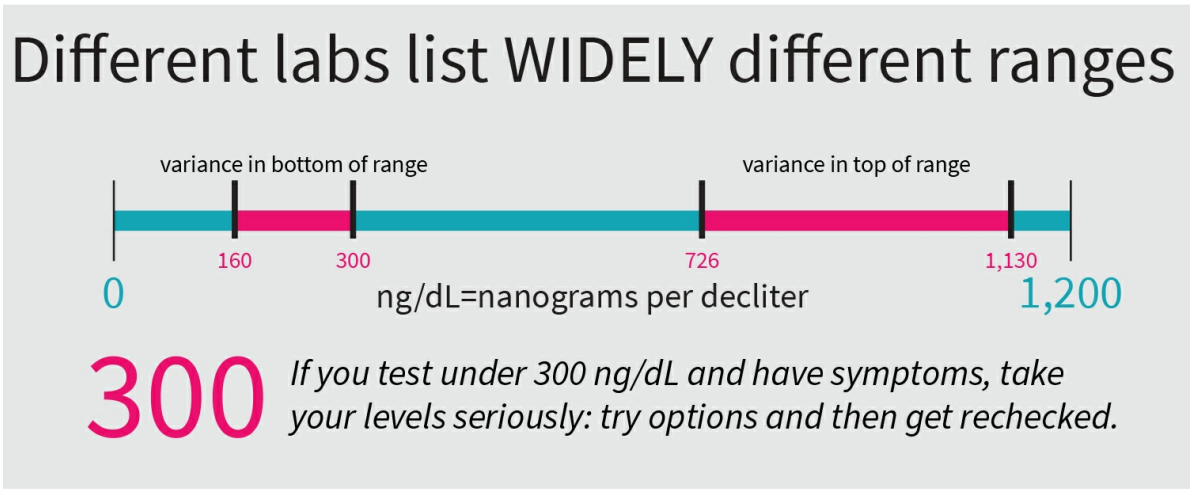
- **Tightly bound testosterone:** About two-thirds of the T in blood is bound to *sex-hormone-binding globulin* (SHBG). The body can't use it.
- **Loosely bound testosterone:** About a third of the T in the blood is bound to albumin. The body can use it, with some effort.
- **Free testosterone:** A small percentage of the T in blood (1–4%, as a rule) floats around freely. The body can readily use it.

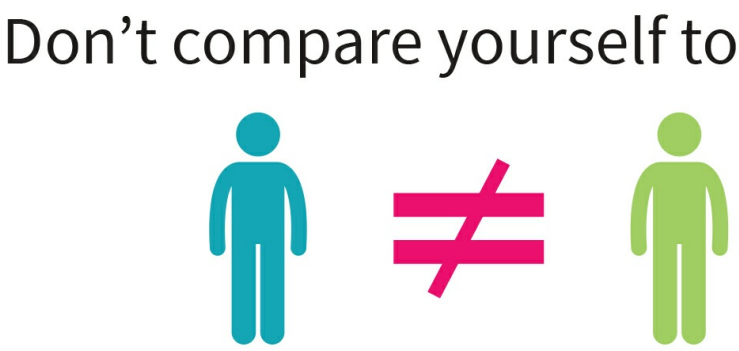
Together, **loosely bound T** and **free T** comprise **bioavailable T**, which has a greater impact on health than **total T** does. For that reason, SHBG is often tested at the same time as total T: the higher the SHBG, the lower the bioavailable T.

We mentioned earlier that putting too much stock in numbers is a mistake. One reason is that normal levels may greatly differ from man to man. If a person, feeling under the weather for no apparent reason, decides to get their T tested and finds they have low levels, they're likely to think *So that's why!* It may even be a relief to have found *the* cause of the problem, because then they can start addressing it.

Except, maybe their levels were already low, when they felt perfectly fine; in other words, T levels could be lower than average but not low *for that person*. If, for instance, the body's androgen receptors are more sensitive than average, the body would need to produce less T than average. The only way to know if feeling crappy might be linked to a drop in T levels is to have had T levels tested *before* feeling crappy.

Another reason to avoid putting too much stock in numbers is that the normal range for total T can vary greatly from lab to lab: from 160 to 300 nanograms per deciliter (ng/dL) at the bottom of the range and from 726 to 1,130 ng/dL at the top of the range.[11]


*If you had high levels and they plummeted, your situation is different from that of someone who’s always had moderately low levels. There is no one best level.*

So a T level of 280 ng/dL may or may not be considered abnormally low, depending on the lab.

## Age is just a number … except when it comes to testosterone

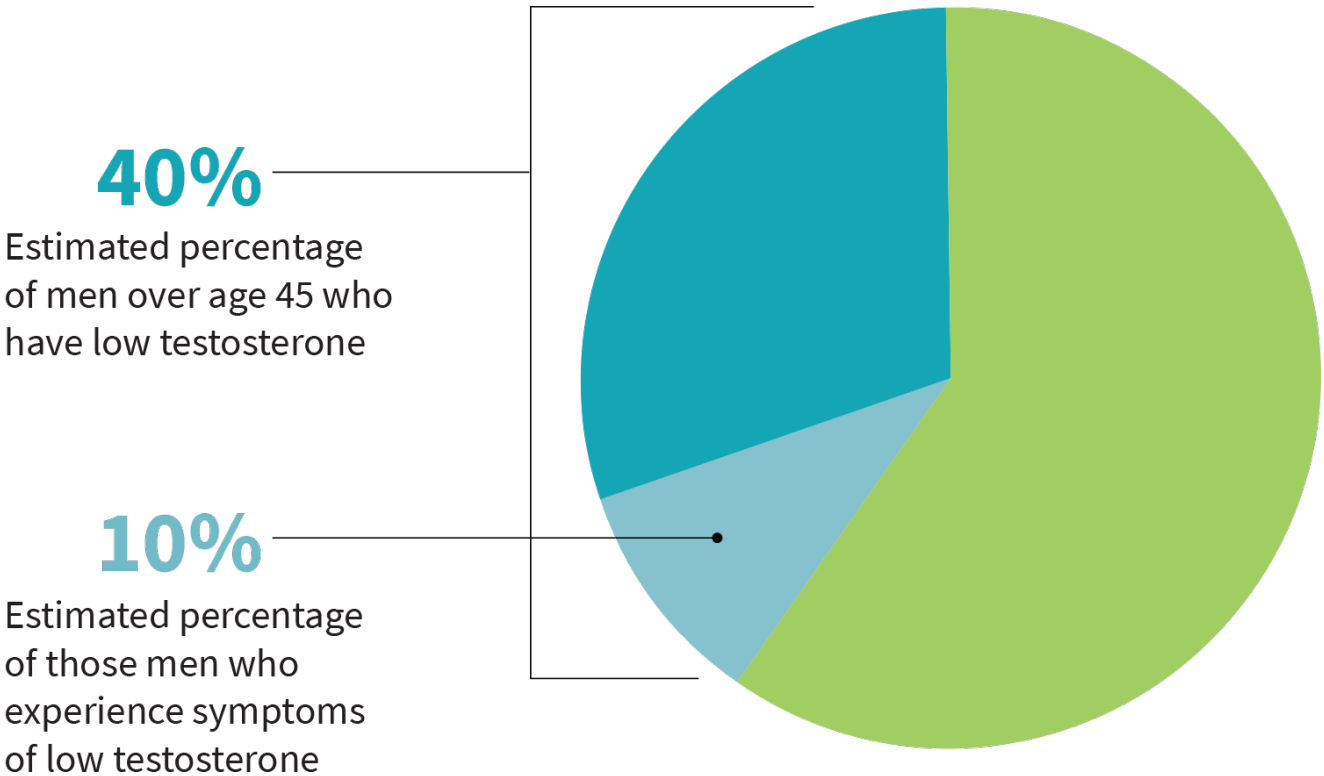
Many supplement companies would like men to believe that plummeting testosterone as they get older heralds doom. This age-related drop even has a fancy-sounding name: andropause. Oh no, my androgens have paused! What do I do?!

Here’s what: Pause, back away from the supplement bottle, and look at what the evidence actually says.

Men start experiencing a yearly drop in total T (0.4–2%) and bioavailable T (2–3%) in their 30s.[12][13] But is this drop caused entirely by the aging process? As with muscle mass, nobody really knows what a "natural" decline in testosterone looks like in humans. We know we lose muscle mass and T as we age,[14][15] but how much of this loss is attributable to the aging process itself, and how much to middle-aged men exercising less (no more getting ripped to attract a partner), eating worse, and spending more time at home (caring for family)?

> 💡 **Tip: Find a way to stay accountable as you age**
>
> The dip (or plummet) in testosterone you experience as you get older can certainly worsen fat gain and muscle loss, but not as much as habit changes can. Seniors, especially women, are substantially less likely than other adults to meet their recommended levels of physical activity,[16] and the body, being a miser, won't expend calories to maintain muscles that aren't regularly challenged.
>
> Although seniors' decline in physical activity is highlighted, that doesn't mean the average middle-aged adult *does* get enough exercise. Between prolonged work schedules and other responsibilities, such as child-rearing, it's all too easy to neglect diet and exercise, so you may want to "outsource" your accountability. A workout buddy, running or walking group, or supportive gym can help on the exercise front; and if you find it hard to stick to a diet, you might want to find a friend with a similar problem, even if just to chat about how eating is going.
>
> A healthier diet in middle age translates to fewer health issues in old age. And more exercise in middle age translates to less sarcopenia (age-related muscle loss) in old age.[17]

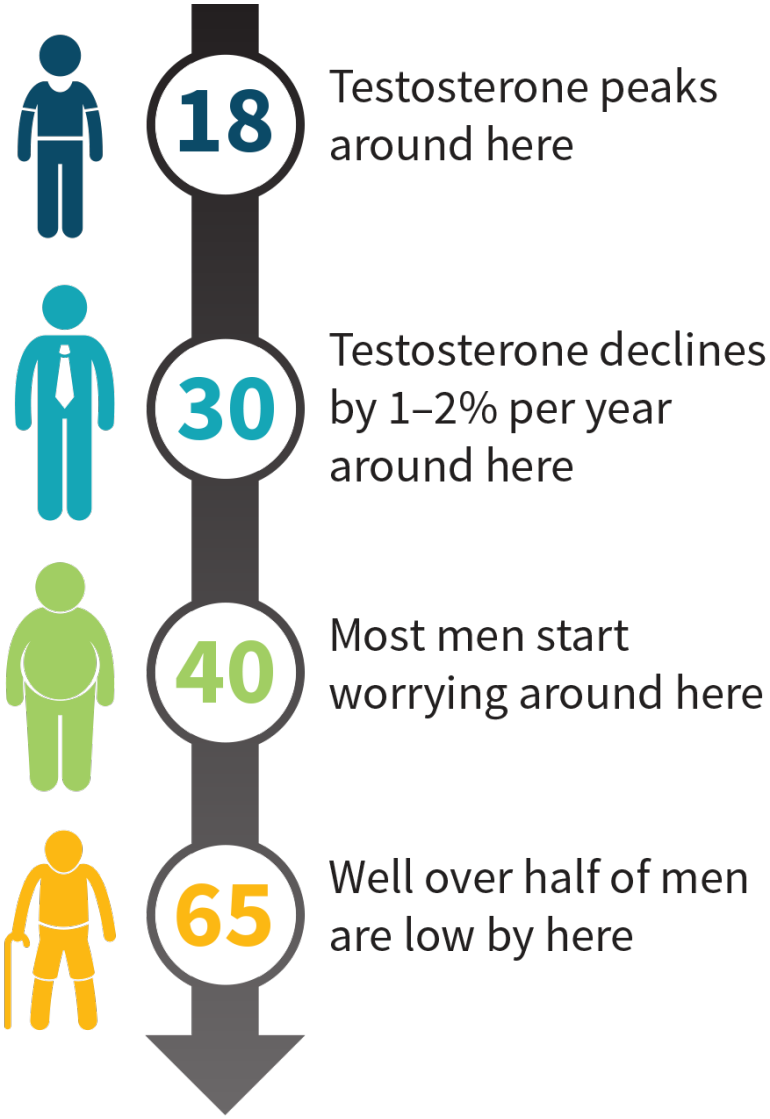
Also, remember when we said that almost 40% of men over age 45 have low T? Well, there's a wrinkle in that story, and it's an important one. Only 10% of those men have *symptoms* of low T.[8]




So there's a mismatch: some men with low T have symptoms, while others feel okay or even great. Moreover, symptoms often don't change when testosterone is prescribed to elderly men with low-normal T

levels.[18] This confirms our previous observation that someone can feel crappy and have low T without the two factors being causally linked.

**Testosterone decreases with age**




# How to boost testosterone

Boosting testosterone can be a game changer for some people (men *and* women). Unsurprisingly, it was among the first topics requested for a Supplement Guide. But you should also be thinking about the forest, not just the trees. Why is the level of testosterone low? What else might be going on?

Diet and testosterone are linked in too many ways to count, but we'll mention two. **First**, diets very low in calories or fat are likely to reduce T over time. **Second**, carrying extra pounds can lead to a vicious cycle:

1. Extra body fat leads to worse metabolic health, and both lead to lower testosterone.[19]
2. If lower testosterone makes a person feel crappy, they're more likely to stress-eat[20] and less likely to exercise.
3. More stress-eating and less exercise is a recipe for weight gain, which circles right back to no. 1.

Testosterone can also plummet if a person sleeps too little, stresses too much, or even works out too much (because too much cortisol, which is produced during exercise, can result in lower T).[21]

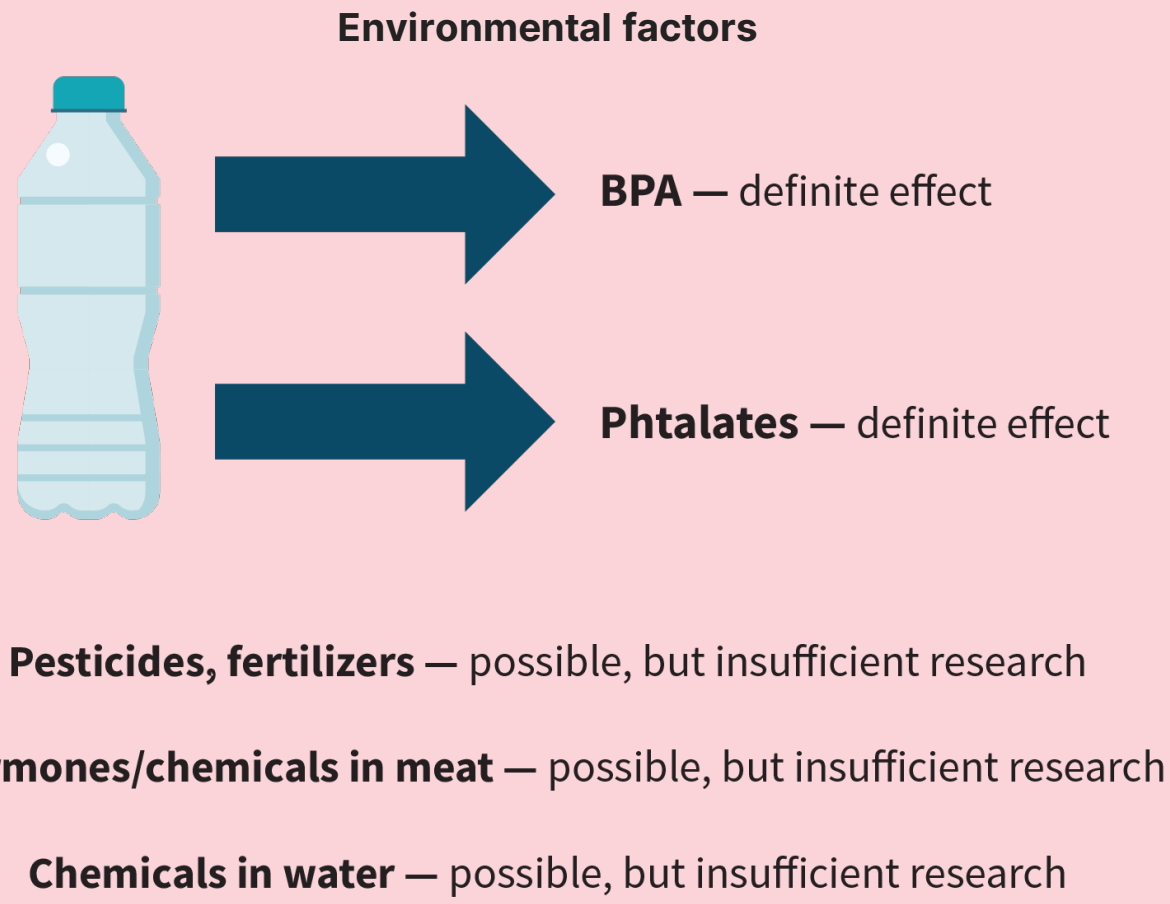
Other negative factors range from alcohol to BPA, a chemical that used to be in water bottles and is still found in receipts and some kitchen items.[22] But only high doses of alcohol are likely to decrease T levels. For most people, too much stress, too little sleep, and either too much or too little food are more likely to be factors in low-T issues.

⚠️ **Caution: Plastics can still be an issue**

Over millennia, various materials have been used to contain beverages and foods. Each material — glass or metal, wood or animal hide — has pros but also cons, from being fragile to altering the taste of its contents.

For decades, starting in the 1960s, plastic made with *bisphenol A* (BPA) was considered the ideal material: light, resilient, and less likely than other plastics to absorb odors. Since then, however, BPA has been shown to interact with estrogen receptors and potentially cause a plethora of adverse effects in fetuses, infants, children, and adults (of both sexes).[23]

Eating canned foods (such as soup, fruit, or the canned foods going into the dishes you order) can expose you to BPA,[24] as can handling a high volume of paper receipts or handling receipts frequently.[25] Even though BPA is seldom used to make bottles anymore, many plastic bottles advertised as BPA-free can release estrogenic chemicals.[26] Those exposures won't necessarily tank your T levels, but several alternatives exist, such as glass or metal bottles, plus using less plastic is a good idea in general.




Prescription testosterone isn't always necessary to feel better. For some men, yes, taking T will be the only

option that works; but for many others, a change in habits will do the trick. And for other people still, testosterone isn't even to blame for how they feel. There are a million and one reasons to be fatigued and have a lower libido than usual!

Also, as you keep reading this guide, you'll notice that some of the best-researched and most-effective supplements for testosterone are also nutrients. When it comes to optimizing T levels, correcting a nutrient deficiency is much more reliable than purchasing the latest hyped-up supplement backed by only three studies (two of them in rats).

*Kamal Patel*, Co-founder and Director
*MBA, MPH, PhD(c) in Nutrition*

# Combos

# Core Combos

## For general testosterone support, before trying anything else

It may be wise to double-check levels of essential nutrients in general before taking anything nonessential. Ensuring sufficient intake of these nutrients may reduce the likelihood of abnormally low T levels but are unlikely to produce large increases for most people — and very unlikely to result in effects beyond deficiency correction. Once the body has enough, further supplementation is pointless.

In particular, one essential nutrient has been verified to have a meaningful effect on low T levels, so it makes sense to try it first.

Zinc

One of the following doses, depending on blood plasma zinc status (more information in the zinc section below), should be taken daily in the form of zinc sulfate or gluconate. No intervention should be started without first discussing it with a physician.

- **Mild deficiency:** 30–40 mg for 2–4 weeks to raise levels to normal, after which 10–20 mg should suffice for maintenance
- **Lower end of the normal range:** 5–20 mg to maintain normal levels
- **Higher end of the normal range:** 5 mg to maintain normal levels
- **Intoxication:** Professional medical advice should be sought out. Any supplement containing zinc should be stopped, unless otherwise instructed by a medical professional.
- **Unknown:** Testing levels first would be prudent, but if that's not feasible, dosage should be limited to 5–20 mg/day (15–25 mg/day for vegetarians and vegans).

If nausea or discomfort is present, taking the zinc with food that is not rich in phytates (e.g., grains, legumes, seeds, and nuts) could help, as those foods may reduce zinc absorption.

Magnesium and vitamin D have not been confirmed to help with low T, but low levels of the mineral or vitamin may be worth correcting anyway.

💡 **Tip: Why don't you recommend specific supplement brands or companies?**

We are 100% independent and extremely serious about being unbiased when it comes to nutrition and supplement information. We only care about the science.

Our goal is to break down and make sense of research. We do not sell supplements or recommend any brands, nor do we do any consulting or accept advertisements, donations, or sponsorships.

Because we don't sell or recommend supplement brands, we have less incentive to hype any of them up or misrepresent any research.

Having said all that, we are interested in keeping people safe. So here's a list of steps that can be taken if a supplement looks interesting.

# Specialized Combos

## For young men (<35 years old) who want to increase their testosterone levels

Disclaimer: Herbal supplements have the potential to interact negatively with medications and with each other. Using multiple herbal supplements together increases the chances of adverse effects, so it may be wise to limit the number taken.

Young men can take 600–675 mg of KSM-66 ashwagandha extract or 240–600 mg of Shoden ashwagandha. The latter contains 35% withanolide glycosides, so a supplement with the equivalent amount may suffice, but all of these doses and forms are speculative, and optimal doses aren't yet known.

If ashwagandha proves insufficient:

Add 500–600 mg of fenugreek per day, divided into two doses. Optimal doses and forms aren't yet known.

## For middle-aged men who want to support their testosterone levels

If levels of the hormone DHEA-S are low, middle-aged men can consider supplementing with 20 mg of DHEA daily, under the supervision of a doctor, for at least a month. If DHEA levels are elevated, adding more increases the risk for side effects and should be avoided. If blood tests come back normal but higher testosterone levels are still desired, the DHEA-S dose can be increased to 50 mg for another month. Even though further increases in supplementation would likely increase T levels more, they aren't advised due to a lack of confidence in their safety.

Disclaimer: It should be noted that over-the-counter DHEA supplements are not legal in all jurisdictions, and it is the user's responsibility to ensure the legality of supplement usage. We do not encourage DHEA use

within jurisdictions where it is a controlled substance.

If DHEA has proven insufficient, 600–675 mg of KSM-66 ashwagandha extract or 240–600 mg of Shoden ashwagandha can be taken. The latter contains 35% withanolide glycosides, so a supplement with the equivalent amount may suffice, but all of these doses and forms are speculative, and optimal doses aren't yet known.

If ashwagandha proves to be insufficient, add 500–600 mg of fenugreek per day, divided into two doses. Optimal doses and forms aren't yet known.

Disclaimer: Herbal supplements have the potential to interact negatively with medications and with each other. Using multiple herbal supplements together increases the chances of adverse effects, so it may be wise to limit how many are taken.

## For middle-aged women who want to support their testosterone levels

If levels of the hormone DHEA-S are low, middle-aged women can take 10–30 mg of [DHEA per day, under the supervision of a doctor. It's ideal to start at the low end of the range for a month and then get tested again, only increasing the dose if the previous dose was insufficient. If DHEA levels are high, adding more increases the risk for side effects and should be avoided

Disclaimer: It should be noted that over-the-counter DHEA supplements are not legal in all jurisdictions, and it is the user's responsibility to ensure the legality of supplement usage. We do not encourage DHEA use within jurisdictions where it is a controlled substance.

Due to an unfortunate lack of evidence specific to women, the following herbs are more speculative.

Women can take 600–675 mg of KSM-66 ashwagandha extract or 240–600 mg of Shoden ashwagandha. The latter contains 35% withanolide glycosides, so a supplement with the equivalent amount may suffice, but all of these doses and forms are speculative, and optimal doses aren't yet known.

If ashwagandha proves to be insufficient:

Add 500–600 mg of fenugreek per day, divided into two doses. Optimal doses and forms aren't yet known.

Disclaimer: Herbal supplements have the potential to interact negatively with medications and with each other. Using multiple herbal supplements together increases the chance of adverse effects, so it may be wise to limit how many are taken.

# What has changed since the last time?

It should be noted that we changed the names of our ranking categories. "Core" (the highest) is now "primary"; "primary" is now "secondary"; and "secondary" is now "promising". This has already been implemented for some guides, but this is the first update to the Testosterone Guide that uses this new terminology. For example, if it was a core supplement in the previous issue and now it's a secondary supplement in this issue, we'll say that it was a primary supplement in the previous issue and is now a secondary supplement.

Added:

- Fenugreek
- Maca
- *Tribulus terrestris*
- Ginger
- *Mucuna pruriens*

Changed ranking:

Vitamin D

*Downgraded* from primary supplement to unproven. This change reflects our new standards, which require good evidence from randomized trials in all cases. Although vitamin D's role is mechanistically plausible, the trials simply haven't demonstrated an effect, and while it makes sense to ensure normal vitamin D levels anyway, vitamin D shouldn't be expected to increase testosterone levels.

Zinc

*Downgraded* from primary to secondary due to a lack of high-quality evidence.

Ashwagandha

*Upgraded* from unproven to secondary. Evidence continues to accumulate, and although it's still preliminary, the consistency of positive effects makes us somewhat confident that ashwagandha can increase testosterone levels.

Magnesium

*Downgraded* from secondary to unproven. Similar to vitamin D, despite plausibility, there is insufficient evidence (but magnesium doesn't seem as unlikely as vitamin D, due to the scarcity of research on the latter).

*Coleus forskohlii*

*Downgraded* from promising to unproven. This new version of the guide puts more weight on evidence from clinical trials and less weight on mechanistic plausibility. It may still turn out to have effects, but we need more evidence.

Stinging nettle

*Upgraded* from inadvisable to unproven. There is insufficient evidence that stinging nettle is ineffective, but there is also insufficient evidence that it *is* effective.

Libido enhancers and testosterone boosters

*Removed.* This section previously made the simple point that just because something may be a libido enhancer doesn't mean it boosts testosterone, using *Tribulus terrestris* as an example. However, we decided to write a section on *Tribulus terrestris* instead.

# Primary Supplements

## Why are there no primary supplements in this guide?

None of the supplements we reviewed for this guide qualified as primary supplements. Either the effects were too small or only present in the case of deficiency, or the evidence wasn't sufficient to give us a high level of confidence.

# Secondary Supplements

# Zinc

## What makes zinc a secondary supplement

Zinc, an important mineral for general health, is often marketed as a testosterone booster. However, supplementation with zinc can only help when low testosterone levels are linked to a zinc deficiency. For example, in a trial published in 2010, in 95 chronic renal failure patients with zinc deficiency, supplementation with 250 mg of zinc sulfate for 6 weeks resulted in a 90% increase in testosterone levels.[27] Similarly, in an earlier trial, in 5 older men with mild zinc deficiency, supplementation with 30 mg of elemental zinc (from zinc gluconate) for 6 months resulted in a 93% increase in testosterone levels.[28] Moreover, meaningful increases in testosterone levels have been observed in studies in which the participants' baseline serum zinc and/or testosterone levels were toward the lower end of the normal range.[29][30] and in a study where zinc levels were not clear.[31]

> 💡 **Tip: Test testosterone levels**
>
> There are blood tests for either free testosterone or total testosterone, which comprises free testosterone and bound testosterone. Testosterone can be weakly bound to albumin or strongly bound to sex hormone binding globulin (SHBG). Testosterone bound to albumin can be freed; testosterone bound to SHBG cannot. Only free testosterone is able to affect the body.

If serum zinc and/or T levels are already well within the normal range, supplementation with zinc is less likely to result in meaningful increases in testosterone levels.[32] One study didn't find an effect after varicocelectomy either.[33]

## Warnings about zinc

Zinc is considered safe for adults in amounts <40 mg/day.[34] When this level of intake is exceeded, nausea, vomiting, stomach cramps, and even diarrhea can occur.[34]

## Effects of low, adequate, and high zinc intake


At the same time, insufficient zinc intake can also cause gastrointestinal issues; it's all about balance. If too much zinc is taken — generally, >100 mg — for a long time, it can also decrease levels of copper, an important mineral needed for iron absorption and red blood cell formation.[35] Chronic zinc consumption or very high doses over a short period may also decrease the immune response[36] and reduce levels of HDL-C.[34] Zinc can also interact with quinolone and tetracycline antibiotics, such as ciprofloxacin and doxycycline.[37][38] Taking zinc along with these antibiotics can reduce the amount of each that is absorbed. To reduce this effect, the antibiotic should be taken at least 2 hours before or 4–6 hours after zinc.[39][40] Other medicines, such as chlorthalidone and hydrochlorothiazide, can increase zinc in urine, so taking these thiazide diuretics could decrease the amount of zinc in the body.[41] Knowing what dietary supplements a person takes is important for doctors and pharmacists so they can check for any interactions.

Tolerable Upper Intake Levels (ULs) of Zinc in Milligrams

| AGE | MALE OR FEMALE (including pregnant or lactating women) |
|---|---|
| 0–6 months | 4 |
| 7–12 months | 5 |
| 1–3 years | 7 |
| 4–8 years | 12 |
| 9–13 years | 23 |
| 14–18 years | 34 |
| >18 years | 40 |

*Reference:* Zinc[34]

# How to take zinc

First, a person should determine whether a zinc supplement is necessary. This can be done by checking current blood plasma levels, but this test is not always the most accurate,[42] so it can be more helpful to track food intake for a week to determine a person's average dietary zinc intake.

If, on average, a person is getting less than 80% of the Recommended Dietary Allowance (RDA), supplementation is an option, but eating more foods rich in zinc should be tried first.

Blood plasma zinc recommendations

| HEALTH STATUS | µmol/L | µg/dL |
|---|---|---|
| Severe deficiency | <4.6 | <30 |
| Deficiency | 4.6–9.0 | 30–59 |
| Mild deficiency | 9.1–12.7 | 60–83 |
| Normal | 12.8–24.3 | 84–159 |
| Intoxication | >24.3 | >159 |

*Reference:* [43]

In case of **deficiency or severe deficiency**, a medically supervised intervention is needed. *Supplementing should always be discussed with a physician first.* Common medical interventions include taking a short-term oral dose of 1–2 milligrams per kilogram of body weight per day (mg/kg/day) of elemental zinc[44]; for severe deficiency, 3 mg/kg/day may be used.[45][46]

In cases of **mild deficiency**, 30–40 mg of elemental zinc daily for 2–4 weeks may raise zinc levels to normal, at which point 10–20 mg/day may suffice for maintenance.

For people on the **lower end of the normal range** (12.8–16.7 µmol/L; 84–109 µg/dL), 5–20 mg of elemental zinc daily may help maintain normal levels.

For people on the **higher end of the normal range** (18.6–24.3 µmol/L, 121.5–159 µg/dL), a zinc supplement may not be necessary, but taking 5 mg of elemental zinc daily may help maintain normal levels.

In cases of zinc **intoxication** (which can cause serious adverse effects), zinc and zinc-containing supplements should be avoided, unless specifically instructed by a medical professional. As always, it's important to first consult a physician.

**If zinc levels are not known** and a person cannot get them tested but are intent on supplementing with zinc, it may be prudent to limit the dosage to 5–20 mg/day (15–25 mg/day for vegetarians and vegans).

While the RDA of zinc for adults ranges from 8 to 12 mg/day[34], any recommendation of ours above that still falls below zinc's Tolerable Upper Intake Level (UL) of 40 mg/day.[34]

**Zinc sulfate** and **gluconate** are the most researched forms of oral zinc supplements and are preferred. **Zinc citrate** has comparable absorption to gluconate, whereas **zinc oxide** isn't as well absorbed.[47] **Zinc picolinate** and **bisglycinate** may have greater absorption rates than gluconate, but more research is needed.[48][49]

Eating foods rich in phytates — namely, grains, legumes, seeds, and nuts[50][51] — at the same time as taking a zinc supplement can reduce zinc absorption. If a person is unable to take zinc on an empty stomach, the

next best way is with some low-phytate food.

Men taking zinc may see a change in testosterone of -0.1–5.124 nanomoles per liter (nmol/L) / -2.58–147.7 nanograms per deciliter (ng/dl). Greater effects are more likely when baseline zinc and testosterone levels are lower. It is unclear to what extent zinc affects women's testosterone levels.

# DHEA

## What makes DHEA a secondary supplement

The hormone *dehydroepiandrosterone* (DHEA) circulates throughout the body and can be called on to make other hormones, notably testosterone and estrogen.[52] DHEA levels decrease with age — sometimes drastically. Maintaining adequate DHEA levels can help support testosterone levels, libido, and sexual function.

Numerous randomized, placebo-controlled clinical trials have been conducted on supplementation with DHEA for a variety of reasons and in a number of contexts. A meta-analysis pooled 42 studies with 55 total arms and found that DHEA had a considerable effect on testosterone levels for both women and men.[53]

The effect was higher for doses above 50 mg compared with lower doses, and trials lasting 12 or fewer weeks showed higher increases than longer trials did. It appeared to work for all of the participants, including postmenopausal women, women not in menopause and with no chronic health conditions, people with chronic health conditions, and women with androgen deficiency, though the most potent effect was seen in the participants not in menopause and with no health conditions. Overall, the study quality has been moderate-high by conventional measures, which is a reason for confidence in DHEA's effects.

## Warnings about DHEA

Because DHEA levels are different for everyone, adding more on top of what's naturally there without knowing base levels could lead to an increased risk of potentially serious side effects. Taking DHEA in dosages higher than 50–100 mg/day or for a long time can increase levels of DHEA, estrogen, androstenedione, and testosterone considerably, which could lead to a sex hormone imbalance and its associated side effects.[54] DHEA has mild side effects, such as acne.[55] Other side effects vary by sex. Women might develop masculine features, and men might experience breast tenderness/enlargement. Men might also experience aggression or testicular wasting, depending on the amount of DHEA consumed. Other potential side effects involve the liver,[56][57] heart,[58] or endocrine system.[59] Because DHEA can be converted into estrogen, people with hormone-sensitive cancers, such as prostate, breast, or ovarian, should not take the supplement. DHEA may also increase the risk of prostate, liver, breast, and pancreatic cancers.[60][61][62][63] The supplement should not be used by pregnant or breastfeeding women, as DHEA can cause higher than normal levels of androgens, which may be harmful to the baby. It's wise to be cautious when taking DHEA in combination with some medications, including anastrozole, exemestane, and fulvestrant.[64] Talking with a doctor before adding any supplements to the diet is important.

## How to take DHEA

The first step is to get tested. The body synthesizes *DHEA sulfate* (DHEA-S) out of DHEA. Blood levels of DHEA can change quickly, but DHEA-S is more stable, so knowing DHEA-S levels is a good idea.

Normal DHEA-S ranges (µg/dL / µmol/L)

| AGE | MEN | WOMEN |
|---|---|---|
| 18–19 | 108–441 / 2.92–11.91 | 145–395 / 3.92–10.66 |
| 20–29 | 280–640 / 7.56–17.28 | 65–380 / 1.75–10.26 |
| 30–39 | 120–520 / 3.24–14.04 | 45–270 / 1.22–7.29 |
| 40–49 | 95–530 / 2.56–14.31 | 32–240 / 0.86–6.48 |
| 50–59 | 70–310 / 1.89–8.37 | 26–200 / 0.70–5.40 |
| 60–69 | 42–290 / 1.13–7.83 | 13–130 / 0.35–3.51 |
| >69 | 28–175 / 0.76–4.72 | 17–90 / 0.46–2.43 |

*Reference:* [65]

- If levels are **normal**, no DHEA is needed.
- If levels are **above normal**, DHEA should not be taken. Speaking to a physician is important.
- If levels are **below normal**, supplementation with DHEA should be discussed with a physician.

Anyone who decides to supplement should try taking DHEA once a day in the morning (with food) for a month and then getting tested again.

- **Men** can take 20–50 mg/day.
- **Women** can take 10–30 mg/day.

These doses should sufficiently maintain adequate DHEA levels. In cases of very low DHEA, 50 mg/day may be needed, regardless of sex.

Men may see an increase in DHEA levels of 0.12–1.38 nmol/dl (3.6–39.91 ng/dl).

Women may see an increase of 0.79–1.18 nmol/dl (23–34 ng/dl).

Postmenopausal women may see an increase of 0.55–1.19 nmol/dl (15.8–34.3 ng/dl).

People with androgen deficiency or other chronic health conditions may see a smaller increase than people without such diagnoses.

# Promising Supplements

# Ashwagandha

## What makes ashwagandha a promising supplement

Ashwagandha is an Ayurvedic herb known for its potential rejuvenating and vitality-enhancing properties.[66] In animal studies, it has demonstrated potential protective effects on the testes in chronic stress and arsenic toxicity, which may be relevant to humans.[67][68]

A number of studies have found that ashwagandha increases testosterone levels, but relatively few were double-blind RCTs, all of which suggested only small-to-moderate increases.[69][70][71][72] The RCT sample sizes were fairly small, and other potential sources of bias limits their ability to accurately assess testosterone levels. The non-RCT trials also supported ashwagandha's testosterone-increasing potential.[73][74][75]

So while the quality of evidence is low, and it's clear that the research is in its infancy, there's a high level of consistency that suggests testosterone increases.

## Warnings about ashwagandha

Ashwagandha continues to show promising efficacy and safety data. Mild side effects reported with the use of ashwagandha include drowsiness, upper *gastrointestinal* (GI) discomfort, dizziness, and loose stools.[76] Because ashwagandha may increase testosterone levels,[71] people with hormone-sensitive prostate cancer should avoid it. The herb's hormonal effects could raise concern about its use during pregnancy, but the research is mostly old, sparse, and unclear.[77] Given the lack of data, it's safest to avoid ashwagandha while pregnant or breastfeeding. There have also been case reports illustrating ashwagandha's potential link to liver injury.[78] Ashwagandha should not be taken with benzodiazepines, anticonvulsants, or barbiturates, because all of these drugs have sedative properties, as does ashwagandha, and combining them can increase these effects.[76] Herbs can be contaminated with arsenic, cadmium, and lead, and ashwagandha is no different.[79] It is vitally important to purchase supplements from a company that subjects their products to credible third-party testing for purity.

## How to take ashwagandha

Due to the more preliminary nature of the evidence, there isn't a clear optimal dose or form of ashwagandha for increasing testosterone. The higher-quality studies used a daily dose of 600–675 mg of the KSM-66 extract; other studies used 240–600 mg of Shoden, which contains 35% withanolide glycosides. There were also positive — but less reliable — studies that used 5 grams of ground root powder.

An effect-size estimate isn't possible for ashwagandha at the moment.

# Fenugreek

## What makes fenugreek a promising supplement

*Trigonella foenum-graecum*, commonly known as fenugreek, is a plant traditionally used in India and some Arabic regions for its purported health-promoting properties. Recently, fenugreek-seed extract has become popular for its potential effects on testosterone levels. These effects have mainly been attributed to steroidal saponins, a group of glycosides found in fenugreek seeds.

In men, the relatively few controlled trials looking at the effects of supplementation with fenugreek on testosterone levels have produced mixed results. For example, one study of 96 healthy men (average age of 56) found that supplementing with 600 mg of a standardized fenugreek seed extract for 12 weeks increased levels: total serum testosterone by 12% and free testosterone by 9.5%. On the other hand, a study of 84 healthy men (average age of 63) with symptoms of benign prostatic hyperplasia (i.e., an enlarged prostate) found that supplementation with 600 mg of the same fenugreek extract for 12 weeks had no effects on total or free testosterone levels.

Moreover, in an 8-week study of 49 young, resistance-trained men, supplementation with 500 mg of fenugreek seed extract (standardized to 70% trigimannose) had no effect on free testosterone. On the other hand, another 8-week study — of 30 young, resistance-trained men — found statistically significant increases in both total and free testosterone levels when the men supplemented with 500 mg of a different standardized fenugreek seed extract.

Of the two available controlled trials in women, one trial reported small increases in total and free testosterone levels, while the other trial reported a small increase in free, but not total, testosterone levels.

The majority of the relevant controlled trials have reported increases in total and/or free testosterone levels when supplementing with fenugreek seed extract, while the remaining trials have reported null effects. Importantly, no trials have reported statistically significant reductions in total or free testosterone. With that said, the available trials are few, small-scale, and methodologically heterogeneous, and almost all have been funded by manufacturers of fenugreek supplements. On the whole, evidence for fenugreek's potential effects on testosterone is promising, but larger-scale, higher-quality trials are needed to confirm these effects.

## Warnings about fenugreek

In commonly studied doses of up to 600 mg per day, fenugreek seed extract appears to be relatively safe. The reported side effects are mild and include headaches and upper GI issues, such as indigestion/reflux and stomach discomfort.

Allergies to fenugreek have been noted and appear to be associated with the *Leguminosae* family, so people with an allergy to chickpeas or peanuts may also react to fenugreek.

A review on the potential toxicological properties of fenugreek reported testicular toxicity, oxidative stress, and DNA damage in male mice and detrimental effects on fertility and pregnancy in female mice, but these effects have not been confirmed in humans. The dose given to the mice was very high (≥50 mg/kg); based on species conversion, the human dose would be 12.3 times higher than that.[80]

# How to take fenugreek

Due to the heterogeneity (variability in study outcomes due to differences in characteristics between studies), it's difficult to make specific recommendations on the best form of fenugreek. With that said, most studies have used 500–600 mg of fenugreek seed extract per day, divided into two doses, for 8–12 weeks. In one study, the participants reported slight GI discomfort when taking the supplement on an empty stomach, so it may be a good idea to take fenugreek with food.

Men taking a fenugreek supplement may see a change in testosterone levels of -0.24–1.90 nmol/L (-6.9–54.8 ng/dl).

There is insufficient evidence to calculate an estimate for women.

# Unproven Supplements

# Boron

## What makes boron an unproven supplement

Like magnesium and zinc, boron is a dietary mineral. As a supplement, it is sometimes recommended for postmenopausal women with low hormone levels. Some studies have also noted an increase in testosterone in men, including young men, taking 10 mg of boron per day, but this effect is unreliable: its magnitude varies significantly between studies using similar dosages and methodologies.[81][82][83] More research is needed to determine boron's effects on hormone levels and the mechanism behind those effects.

One study on postmenopausal women failed to find a meaningful effect on testosterone levels.[84]

# Coleus forskohlii

## What makes *Coleus forskohlii* an unproven supplement

*Coleus forskohlii* is an herb historically used in Ayurvedic medicine that can increase the body's levels of cyclic adenosine monophosphate, or cAMP, which is important for a number of hormonal processes. It might also increase the effectiveness of other supplements that increase cAMP, such as caffeine. An increase in cAMP levels in the testicles leads to improved testosterone synthesis.

One randomized, double-blind, placebo-controlled trial examined the effects of a forskohlii root extract (manufactured to contain a forskolin concentration of 10%) on testosterone concentrations in 30 young men with overweight or obesity.[85] Daily supplementation with 500 mg for 12 weeks failed to increase total testosterone levels but did increase free testosterone levels by a clinically irrelevant 3%. It's worth keeping in mind that the trial was not preregistered, did not specify primary outcomes, and was funded by the manufacturer of the supplement.

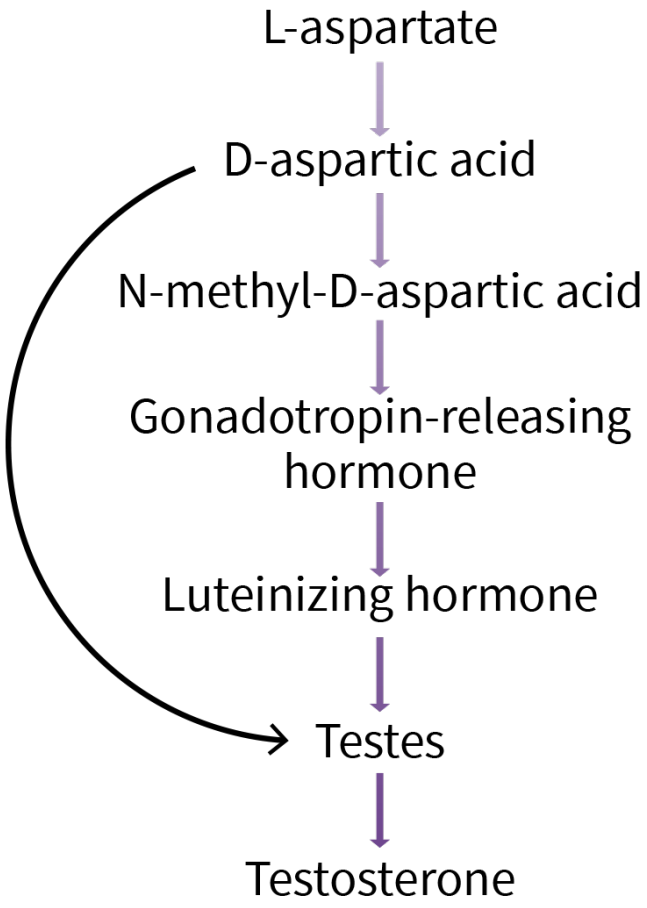
Due to the lack of relevant clinical research, coupled with the unimpressive results of the single available (industry-funded) trial, *Coleus forskohlii* is considered an unproven option.

# D-aspartic acid

## What makes D-aspartic acid an unproven

# supplement

Theoretically, an increase in D-aspartic acid can increase testosterone through metabolism.




**Reference:** D'Aniello. *Brain Res Rev.* 2007.[86]

In reality, it is doubtful that it has any meaningful effect.

Out of six controlled clinical trials of *D-aspartic acid* (D-aspartate, or DAA), testosterone levels:

- increased by 42% in one trial in young men
- decreased by 12.5% in another trial in young, resistance-trained men (but only in the men taking 6 grams of DAA per day, not in the men taking 3 grams per day)
- stayed the same in the remaining four trials

Overall, the few available controlled trials in humans suggest either no or mixed effects of supplementation with DAA on testosterone levels, which is why the supplement is deemed unproven.

# Maca

## What makes maca an unproven supplement

Maca (*Lepidium meyenii*) root has a reputation for increasing virility, which has led to speculation about its effects on testosterone.

None of the trials that have examined maca's effect on testosterone levels have found convincing evidence

of a meaningful increase.[87][88][89][90] It is likely that this confusion stems from maca having an effect on libido, which is incorrectly interpreted as/attributed to an increase in testosterone.[91]

# Magnesium

## What makes magnesium an unproven supplement

Older men with low magnesium levels tend to have lower testosterone levels, and this even holds true when adjusted for age, which rules out the likelihood that age influences both.[92][93][94]

Studies show magnesium plays a role in the functioning of androgenic enzymes in the testes, but this research was done on rats;[95] reliable human studies are generally lacking. One trial found an increase in free and total testosterone when supplementing with magnesium sulfate to achieve 10 mg/kg, but the difference between groups didn't reach statistical significance, and the evidence is very preliminary.[96] The increase in free testosterone is plausible, because magnesium seems to compete for sex hormone–binding globulin, which reduces testosterone binding. Nonetheless, evidence is insufficient to substantiate the potential effects of magnesium.

There was no effect for women with polycystic ovary syndrome when taking 250 mg of magnesium oxide, but again, this is very preliminary evidence.[97]

Who is more likely to have low magnesium levels?

- **Older people** tend to have relatively low magnesium intakes[98] and may absorb less during digestion.[99]
- **People who sweat a lot** lose magnesium through sweat. Athletes who participate in sports that require weight control may be especially vulnerable.
- **People with type 2 diabetes** are at much higher risk for low magnesium. In developed countries, magnesium deficiency is estimated to affect less than 15% of adults without diabetes but up to 50% of adults with type 2 diabetes.[100]

*Reference:* USDA FoodData Central Database. Accessed September 27, 2019.

https://medlineplus.gov/ency/patientinstructions/000381.htm](https://fdc.nal.usda.gov/

In addition, certain diuretics[101], [proton pump inhibitors), and the antifungal medication amphotericin B can cause significant magnesium loss.[102]. However, potassium-sparing diuretics may not lower magnesium. These include amiloride/Midamor, eplerenone/Inspra, spironolactone/Aldactone, and triamterene/Dyrenium.[102]

# *Tribulus terrestris*

## What makes *Tribulus terrestris* an unproven supplement

*Tribulus terrestris* is an herb that frequently appears in supplements purported to increase testosterone levels, and there are trials that suggest some of these products may be effective.[103][104][105] However, the possible efficacy of multi-ingredient supplements containing *Tribulus* should not be construed as evidence for *Tribulus* having a testosterone-increasing effect, because other ingredients could be responsible.

Randomized trials that only use *Tribulus terrestris* tell a different story. Trials lasting 3–5 weeks have failed to find a meaningful effect in men overall,[106][107][108] as have studies in men with sexual problems, such as erectile dysfunction or oligozoospermia (i.e., low sperm count).[109][110][111] The one positive study was in men with hypogonadism (i.e., diminished function in the testes); although it might be tempting to think *Tribulus* works in that context, the increase was moderate, and more studies are needed before we can be confident in that finding.[112]

In women, two randomized trials on hypoactive sexual desire disorder (i.e., low sex drive) found an increase in total and free testosterone.[113][114] But the research is preliminary, and there are still uncertainties surrounding its usefulness and in which contexts it would apply.

# Stinging nettle

## What makes Stinging nettle an unproven supplement

Only one trial has tested stinging nettle and testosterone, and it failed to find a meaningful effect over 18 months.[115] The participants had benign prostatic hyperplasia (i.e., enlarged prostate), so it's possible that different effects would be seen for participants in other contexts. Nonetheless, there's no support for stinging nettle in clinical trials.

# Ginger

## What makes ginger an unproven supplement

Only one human trial — in 75 men, ages 19–40, with infertility — has looked at the effects of ginger on testosterone. It reported a 19% increase in testosterone levels after three months of supplementation with ginger.

However, there are several issues in methodology that greatly reduce our confidence in the results. The study:

- Was not preregistered
- Did not specify primary outcomes
- Included multiple outcomes without making statistical adjustments for multiple comparisons
- Did not have a control group
- Did not provide any information on the supplement form, dose, or intake schedule

Also, the researchers did not disclose if there were any conflicts of interest or how the study was funded.

Moreover, one trial, even if conducted rigorously, is insufficient.

# Mucuna pruriens

## What makes *Mucuna pruriens* an unproven supplement

*Mucuna pruriens*, also known as velvet bean, is a tropical legume native to Africa and tropical Asia that has traditionally been used as an aphrodisiac and to improve fertility in men. Its potential to increase testosterone has been attributed, at least in part, to its high content of L-DOPA, a direct precursor to the neurotransmitter dopamine.[116]

The effects of *Mucuna pruriens* on testosterone have been examined in two clinical trials[117][116] on men ages 20–45 with infertility. For 3 months, the participants took 5 grams per day of *Mucuna pruriens* dried seed powder mixed with milk. In both studies, total testosterone levels significantly increased from baseline, with the greatest increases (+43%) observed in men with oligozoospermia.

However, it should be noted that the studies were conducted by the same research lab, were not preregistered, did not allocate participants to the treatment groups randomly, and included multiple outcomes without making statistical adjustments for multiple comparisons. The researchers did not disclose whether they had any conflicts of interest or how the study was funded either. It's also worth keeping in mind that it's unclear whether the studies were completely separate or if the 2011 study included data on testosterone from the 2009 study.

Because of the above issues and the small number of trials, *Mucuna pruriens* is considered an unproven supplement until more research becomes available.

# Vitamin D

## What makes vitamin D an unproven supplement

The older a person gets, the less efficient the body becomes at synthesizing vitamin D. In addition, it's likely that less time is spent outside, less vitamin D is obtained through foods, and more belly fat is carried (which has been linked to vitamin D deficiency).[118][119] Because vitamin D plays a role in the regulation of testosterone (T) production,[120][121][122] it's logical that maintaining adequate D levels can help ensure adequate T levels,[123][124][125] but studies don't reflect that.

**FOR MEN**

The research simply hasn't shown meaningful effects. Several studies showed either no increase in T levels or an elevation in T by 1.15 nmol/L (33.17 ng/dL) at most.[126][127][128][129][130][131][132][133] Even in the case of low vitamin D levels and low T, there was no effect on average levels.

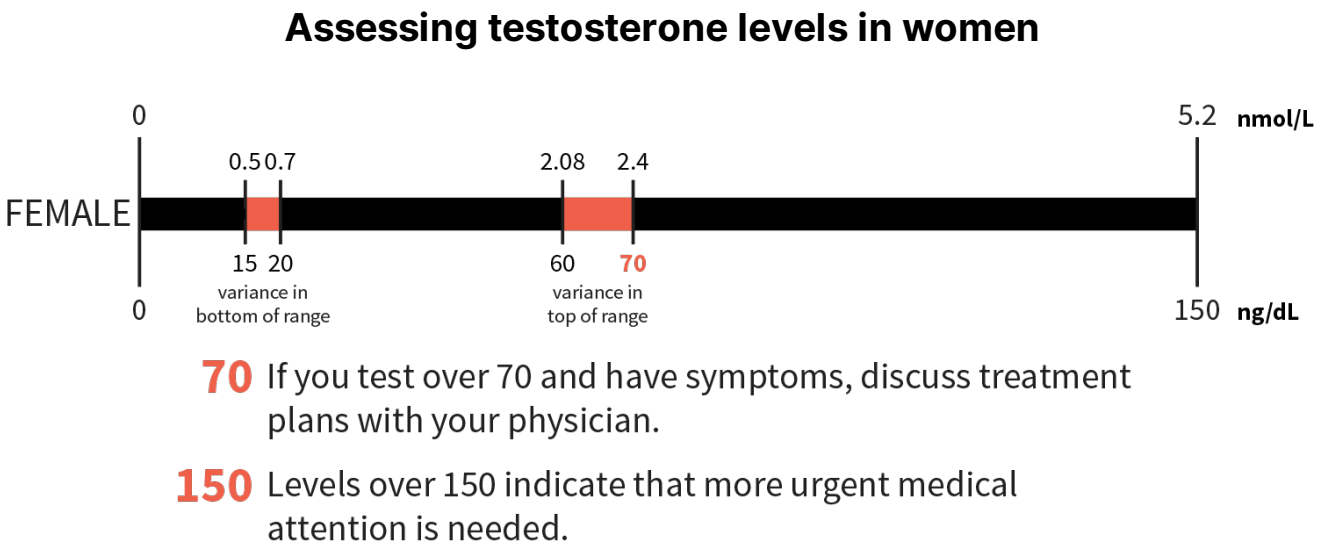
Similarly, supplemental $D_3$ had little to no effect on free testosterone or *sex hormone binding–globulin* (SHBG) in people with insufficient vitamin D levels.[127][132][131][130][126][134][124][129]

Why, then, if vitamin D plays a role in testosterone production, does supplementation not work, even in cases of low vitamin D levels? Probably because low levels doesn't mean no T levels, and it's possible that testosterone production at even low levels is sufficient to regulate testosterone levels. The body will also prioritize its most essential processes when it's lacking something, at the expense of other processes.

**FOR WOMEN WITH PCOS**

Most women with *polycystic ovary syndrome* (PCOS) have elevated levels of androgen hormones, including testosterone, free testosterone, dehydroepiandrosterone (DHEA), and *DHEA sulfate* (DHEAS).[135] These elevated levels can cause body-hair growth, acne flare-ups, and a type of hair loss more consistent with male pattern hair loss than female pattern hair loss.

As with men, vitamin D plays a role in female testosterone regulation. The T levels of adult females normally range from 0.7 to 2.08 nmol/L (20–60 ng/dL), with the lowest levels typically seen during the follicular phase.[136] Levels above this range are an indicator of PCOS.




In 10 randomized trials of 1,077 women with PCOS, the average effect of supplementation with $D_3$ was moderate, with the overall decrease in testosterone spanning from −0.26 to −0.62 nmol/L (−7.59 to −17.85 ng/dL).[137][138][139][140][141][142][143][144][145][146]

The effect was larger in the participants who took $D_3$ along with PCOS drug treatments.

- **Vitamin D + PCOS drugs:** −0.29 to −0.76 nmol/L (−8.36 to −21.92 ng/dL)[138][140][144][145]
- **Vitamin D alone:** 0.00 to −0.52 nmol/L (−0.09 to −15.00 ng/dL)[137][139][141][142][143][146]

Additionally, the effect was modified by vitamin D status. The participants who had insufficient vitamin D at baseline (<20 ng/mL / <50 nmol/L) experienced greater improvements in T.

Most of the trial participants also took prescription drugs, which is common for this condition. Drug

cotreatments included:

- Calcitriol (Rocaltrol)
- Clomiphene (Clomid, Milophene, Serophene)
- Metformin (Fortamet, Glucophage, Glumetza)
- Pioglitazone (Actos, Oseni)
- Spironolactone (Aldactone, CaroSpir)

# Inadvisable Supplements

# Creatine

## What makes creatine an inadvisable supplement

Three RCTs of 60 active young men showed small hormonal increases — one in DHT[147] and the other two in testosterone[148][149] These studies are commonly cited to support the position that creatine can increase testosterone, but the increases were very small and left the participants well within normal ranges.

Ten other RCTs (218 total participants, all men) showed no effect, positive or negative, across many study durations (6 days to 10 weeks) and doses (3–25 grams).[147][150][151][152][153][154][155][156][157][158] To date, there are no studies in men with abnormally low testosterone levels or in women. Given the largely negative research results seen in men, it can be hypothesized that creatine supplementation is unlikely to affect testosterone levels in women.

Lifting weights causes a short-lived increase in testosterone production,[159][160] and creatine allows a person to lift heavier weights, so fueling a workout with creatine could *theoretically* translate to a greater increase in testosterone. But evidence to date indicates it is unlikely to have a meaningful effect on testosterone levels.

A summary of creatine–testosterone studies

| BETWEEN-GROUPS EFFECT | STUDY | SAMPLE SIZE | POPULATION | AVERAGE AGE | DURATION | DOSE | EFFECT ON TESTOSTERONE |
|---|---|---|---|---|---|---|---|
| **Significant** | Arazi 2015 | 20 | Active men | 20 | 1 week | 20 g/day | ↑ |
| | Vatani 2011 | 20 | Trained men | 20 | 6 days | 20 g/day | ↑ |
| **Mixed results** | van der Merwe 2009 | 20 | Male rugby players | 18 | 3 weeks | 25 g/day loading<br>then 5 g/day maintenance | ↑ DHT<br>↔ Test |
| **No effect** | Cook 2011 | 10 | Male rugby players | 20 | 10 weeks | 4.5 grams and 9 grams | ↔ |
| | Cooke 2014 | 20 | Active men | 61 | 12 weeks | 20 g/day loading<br>then 0.1 g/kg 3×/week (avg. 8.8 g/day) | ↔ |
| | Crowe 2003 | 28 | Male rugby players | 25 | 6 weeks | 3 g/day HMB* + 3 g/day creatine | ↔ |
| | Eijnde 2001 | 11 | Untrained men | 20 | 8 days | 20 g/day | ↔ |

| BETWEEN-GROUPS EFFECT | STUDY | SAMPLE SIZE | POPULATION | AVERAGE AGE | DURATION | DOSE | EFFECT ON TESTOSTERONE |
|---|---|---|---|---|---|---|---|
| | Faraji 2010 | 20 | Male sprinters | 21 | 1 week | 20 g/day | ↔ |
| | Hoffman 2006 | 33 | Male football players | College | 10 weeks | 10.5 g/day | ↔ |
| | Rhimi 2010 | 27 | Trained men | 21 | 1 week | 20 g/day | ↔ |
| | Tyka 2015** | 19 | Male runners | 19–30*** | 6 weeks | 0.07 g/kg of lean body mass | ↔ |
| | Volek 1997 | 13 | Active men | 23 | 1 week | 25 g/day | ↔ |
| | Volek 2004 | 17 | Trained men | 21 | 6 weeks | 20 g/day loading<br>then 4 g/day maintenance | ↔ |

* While there was no creatine-only group, studies have not shown HMB *(beta-hydroxy-beta-methylbutyrate)* to independently affect testosterone.[161][162][163][164]

** This study used creatine malate instead of creatine monohydrate.

*** This study reported an age range but not an average age.

# FAQ

## Q. What about the supplements not covered in this guide?

Our guides are regularly updated, often with new supplements. We prioritize assessing (and reassessing) the most popular of them and those most likely to work. However, if there is a specific supplement you'd like to see covered in a future update, please let us know by filling out this survey.

## Q. Can I add a supplement not covered in this guide to my combo?

Supplement with your current combo for a few weeks before attempting any change. Talk to your physician and research each potential addition. Check for known negative interactions with other supplements and pharmaceuticals in your current combo, but also for synergies. If two supplements are synergistic or additive in their effects, you might want to use lower doses of each.

## Q. Can I modify the recommended doses?

If a supplement has a recommended dose range, stay within that range. If a supplement has a precise recommended dose, stay within 10% of that dose. Taking more than recommended could be counterproductive or even dangerous. Taking less could render the supplement ineffective, yet starting with half the regular dose could be prudent — especially if you know you tend to react strongly to supplements or pharmaceuticals.

## Q. At what time should I take my supplements?

The answer is provided in the "How to take" section of a supplement entry whenever the evidence permits. Too often, however, the evidence is either mixed or absent. Starting with half the regular dose can help minimize the harm a supplement may cause when taken during the day (e.g., fatigue) or in the evening (e.g., insomnia).

## Q. Should I take my supplements with or without food?

The answer is provided in the "How to take" section of a supplement entry whenever the evidence permits. Too often, however, the evidence is either mixed or absent. Besides, a supplement's digestion, absorption, and metabolism can be affected differently by different foods. Fat-soluble vitamins (A, D, E, K), for instance, are better absorbed with a small meal containing fat than with a large meal containing little to no fat.

# Q. What are DRI, RDA, AI, and UL?

The Dietary Reference Intakes (DRIs) is a system of nutrition recommendations designed by the Institute of Medicine (a US institution now known as the Health and Medicine Division). RDA, AI, and UL are part of this system.

- Contrary to what the name suggests, a *Recommended Dietary Allowance* (RDA) doesn't represent an *ideal* amount; it represents the *minimum* you need in order to avoid deficiency-related health issues. More precisely, it represents an amount just large enough to meet the minimum requirements of 97.5% of healthy males and females over all ages — which implies that the RDA is too low for 2.5% of healthy people.
- The *Adequate Intake* (AI) is like the RDA, except that the number is more uncertain.
- The *Tolerable Upper Intake Level* (UL) is the maximum safe amount. More precisely, it is the maximum daily amount deemed to be safe for 97.5% of healthy males and females over all ages — which implies that the UL is too high for 2.5% of healthy people.

As a general rule, a healthy diet should include at least the RDA of each nutrient — but less than this nutrient's UL. This rule has many exceptions, though. For instance, people who sweat more need more salt (i.e., sodium), whereas people who take metformin (a diabetes medicine) need more vitamin B12.

Moreover, the DRIs are based on the median weight of adults and children in the United States. Everything else being equal (notably age, sex, and percentage of body fat), you likely need a lesser amount of nutrients if you weigh less, and vice versa if you weigh more. The numbers, however, are not proportional — if only because the brains of two people of very different weights have very similar needs. So you can't just double your RDIs for each nutrient if you weigh twice as much as the median adult of your age and sex (even if we overlook that people weighing the same can differ in many respects, notably body fat).

# Q. I have an iron stomach. I have never felt nauseous from supplements. Do I still need to take precautions to avoid gastrointestinal upset?

If you have never had any issues with nausea or vomiting, you may have an easier time ingesting large doses of certain supplements. Nevertheless, it is not a good idea to disregard the warnings on a product.

# Q. I took 350 mg of supplemental magnesium and experienced diarrhea. Why is that?

If magnesium is indeed the culprit, then your diarrhea was probably caused by too large a dose reaching the colon. Alternatively, it could mean that your body's levels of magnesium are in fact sufficient, making supplementation unnecessary.

In the future, split your daily dose into multiple doses. If the problem persists, reduce your daily dose to 200 mg. If you are using magnesium oxide, switch to a different form of magnesium.

## Q. What's the difference between elemental magnesium/zinc and other kinds of magnesium/zinc?

"Elemental" refers to the weight of the mineral by itself, separately from the compound bound to it. For instance, ingesting 500 mg of magnesium gluconate means ingesting 27 mg of elemental magnesium.

*Product labels display the elemental dosage.* On a label, "27 mg of magnesium (as magnesium gluconate)" means 27 mg of elemental magnesium (and 473 mg of gluconic acid).

## Q. Since the body can use DHEA to make estrogen, shouldn't males avoid supplementing it?

In addition to being a signaling molecule in and of itself, DHEA is the precursor to androgens *and* estrogens. Therefore, yes, DHEA may increase estrogens levels in men, depending on various factors, such as an individual's overall levels of androgens and estrogens. However, feminizing effects haven't been reported.

## Q. Will diet affect my testosterone levels?

Yes, and in too many ways to count! To tackle the big issues, though, you should keep in mind that diets very low in calories or fat are likely to reduce your testosterone over time. Additionally, a diet that leads to fat gain will also decrease testosterone production.

## Q. Will ejaculation decrease my testosterone levels?

Ejaculation results in changes in prolactin (increase) and dopamine (temporary decrease) but does not result in changes in testosterone. Although prolactin and dopamine are both involved with testosterone, they do not appear to influence testosterone levels acutely.

## Q. Will sleep affect my testosterone levels?

Lack of sleep causes numerous health issues. Notably, it can decrease testosterone production[165][166][167][168][169] and facilitate fat gain[170] (and fat gain itself can impair testosterone production). Getting enough quality sleep will help support healthy testosterone levels.

## Q. Will exercise increase my testosterone

# levels?

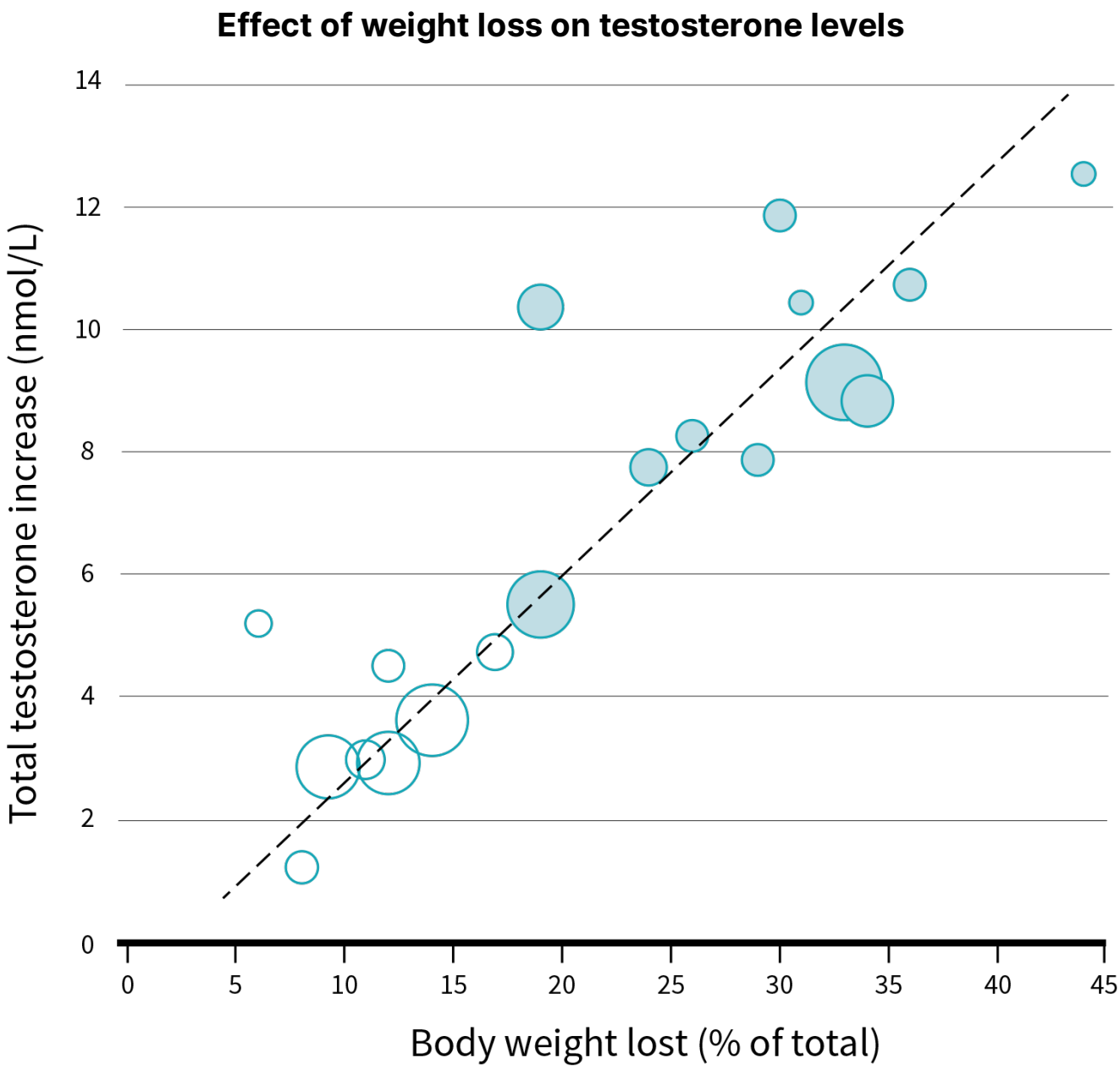
Resistance training can temporarily raise testosterone levels for 15–30 minutes post-exercise.[159][160] More importantly, it can benefit testosterone production in the long run by improving body composition and reducing insulin resistance.[159]

Overtraining, however, is counterproductive. Prolonged endurance exercise especially can cause your testosterone to drop.[21][171] Ensuring adequate recovery time will help you receive the full benefits of physical activity.

# Q. Will gaining fat decrease my testosterone levels?

Fat gain and the associated increase in chronic disease risk, such as cardiovascular disease and type 2 diabetes, are strongly linked to decreases in testosterone, particularly in middle-aged and older men.[172][13][173]

If you gain weight (as fat), your testosterone production drops. Fortunately, if you lose weight, your testosterone production can climb back up.




*Reference:* Grossmann and Matsumoto. *J Clin Endocrinol Metab.* 2017.[174]

A meta-analysis of 24 RCTs looked at weight loss caused by diet or bariatric surgery.[175]

In the diet studies, the average 9.8% weight loss was linked to a testosterone increase of 2.9 nmol/L (84 ng/dL). In the bariatric-surgery studies, the average 32% weight loss was linked to a testosterone increase of 8.7 nmol/L (251 ng/dL).

You need not lose huge amounts of weight to see a bump in testosterone levels, either: a 5% loss in weight may increase total testosterone by 2 nmol/L (58 ng/dL).[176]

# Q. Will soy decrease testosterone levels in males?

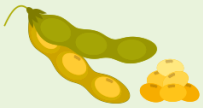
Phytoestrogens are plant compounds structurally similar to estradiol, the main estrogen in males and premenopausal females. Because soy contains isoflavones, a type of phytoestrogen, concern has been raised about soy affecting male health.

To this day, two case reports have documented adverse effects (gynecomastia, hypogonadism, reduced libido, and erectile dysfunction) from an estimated 360 mg of soy isoflavones per day for 6–12 months. However, a meta-analysis of 15 *randomized controlled trials* (RCTs, a much higher level of evidence than case reports) found that males' levels of total and free testosterone were not notably affected by either 60–240 mg of isoflavones or 10–70 grams of soy protein per day.

Accordingly, a couple of scoops of soy protein powder are unlikely to have estrogenic effects in males. If you'd like to take more, however, look for a soy protein concentrate or isolate produced through the alcohol-wash method, which dramatically lowers the isoflavone content.[177]

Keep in mind that the isoflavone content of different soy products can vary depending on several factors, such as the variety of soybeans used, differences in growing and storage conditions, and differential food processing techniques employed.[178] You can see how it varies below.

## Isoflavone content of common soy foods

| Food category | Food | Milligrams of isoflavones per 100 g of food | | |
|---|---|---|---|---|
| | | Average | Minimum | Maximum |
|  Traditional unfermented soy foods | Edamame | 18 | 14 | 19 |
| | Soybeans (boiled) | 65 | 23 | 128 |
| | Soybeans (raw) | 155 | 10 | 440 |
| | Soybean sprouts | 34 | 0 | 107 |
| | Soy milk (unsweetened) | 11 | 1 | 31 |
| | Soy nuts | 148 | 2 | 202 |
| | Tofu | 30 | 3 | 142 |
|  Traditional fermented soy foods | Miso | 41 | 3 | 100 |
| | Miso soup | 1.5 | 1.5 | 1.5 |
| | Miso soup mix (powder) | 70 | 54 | 126 |
| | Natto | 82 | 46 | 124 |
| | Soy sauce | 1 | 0 | 3 |
| | Tempeh | 61 | 7 | 179 |
|  Second-generation soy foods | Soy-based veggie “meats” | 9 | 0 | 23 |
| | Soy cheeses | 26 | 3 | 59 |
| | Soy yogurt | 33 | 10 | 70 |
|  Soy flours and protein powders | Soy flour (defatted) | 151 | 74 | 324 |
| | Soy flour (full-fat) | 165 | 130 | 260 |
| | Soy infant formula (powder) | 28 | 21 | 31 |
| | Soy protein concentrate (alcohol wash) | 12 | 2 | 32 |
| | Soy protein concentrate (water wash) | 95 | 61 | 167 |
| | Soy protein isolate | 91 | 46 | 200 |

*Reference:* USDA FoodData Central Databases. Accessed Jan 18, 2019. URL: https://fdc.nal.usda.gov/

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