

Examine[®]

Sleep Supplement Guide



Written By: Wyatt Brown, Antonis Damianou, & Michael Hull

Edited By: Molly Gregas

Reviewed By: Wyatt Brown, & Molly Gregas

Table of Contents

- Introduction
- Combos
- Primary Supplements
- Secondary Supplements
- Promising Supplements
- Unproven Supplements
- Inadvisable Supplements
- FAQ

Introduction

Nearly twenty years ago, as a young pup researching weightlifting out of my dorm room, I suddenly reached my limit. I thought I knew everything about weights and nutrition (ha!) and it was time to move on to the next topic: sleep science. So I bought an accelerometer-equipped sleep watch on this cool new site called “[eBay](#)”.

Oh my. I was a mild data nerd before then, but the watch turned me into a level 10 nerd. When I got even a bit less sleep, it was highly correlated with lower test scores, more [stress](#), and...gym plateaus! Sleep seemed to be more influential than how much [protein](#) I got, what my lifting routine was, and pretty much anything else.

🔍 Digging Deeper: Sleep tracking? There’s an app for that

In the late 1990s, accelerometer-equipped watches became available for sleep tracking. They weren’t used for clinical sleep assessment — for which dedicated home devices,^[1] clunkier but more accurate, had recently become available to physicians — but they did provide the curious average person with some sleep data.

Fast forward a couple decades, and now anyone with a smartphone can use its accelerometer to track sleep, using cheap or free apps. But are these apps accurate? Can they really tell you how much time you spend in the different stages of sleep^[2] or how efficient your sleep was? Well, according to a recent study...no, not really.^[3]

Still, those apps might bring potential problems to your attention (e.g., if you learn that you get up at the same time every night, you can try to understand why). They may also, very simply, keep you invested in maintaining healthy sleep patterns.

There is anecdotal evidence that a smartphone will track your sleep more accurately if you strap it to your arm or leg rather than lay it on your bed (especially if your bed is of the memory-foam variety). But if you want better data, you can purchase a fitness device. Not all such devices will be equally accurate, however, and any study on a given device is likely to have been funded by the device’s manufacturer.^[4] (Industry funding does *not* disqualify a study, but an industry-funded study is less likely to get published if it doesn’t produce favorable results.)

The problem

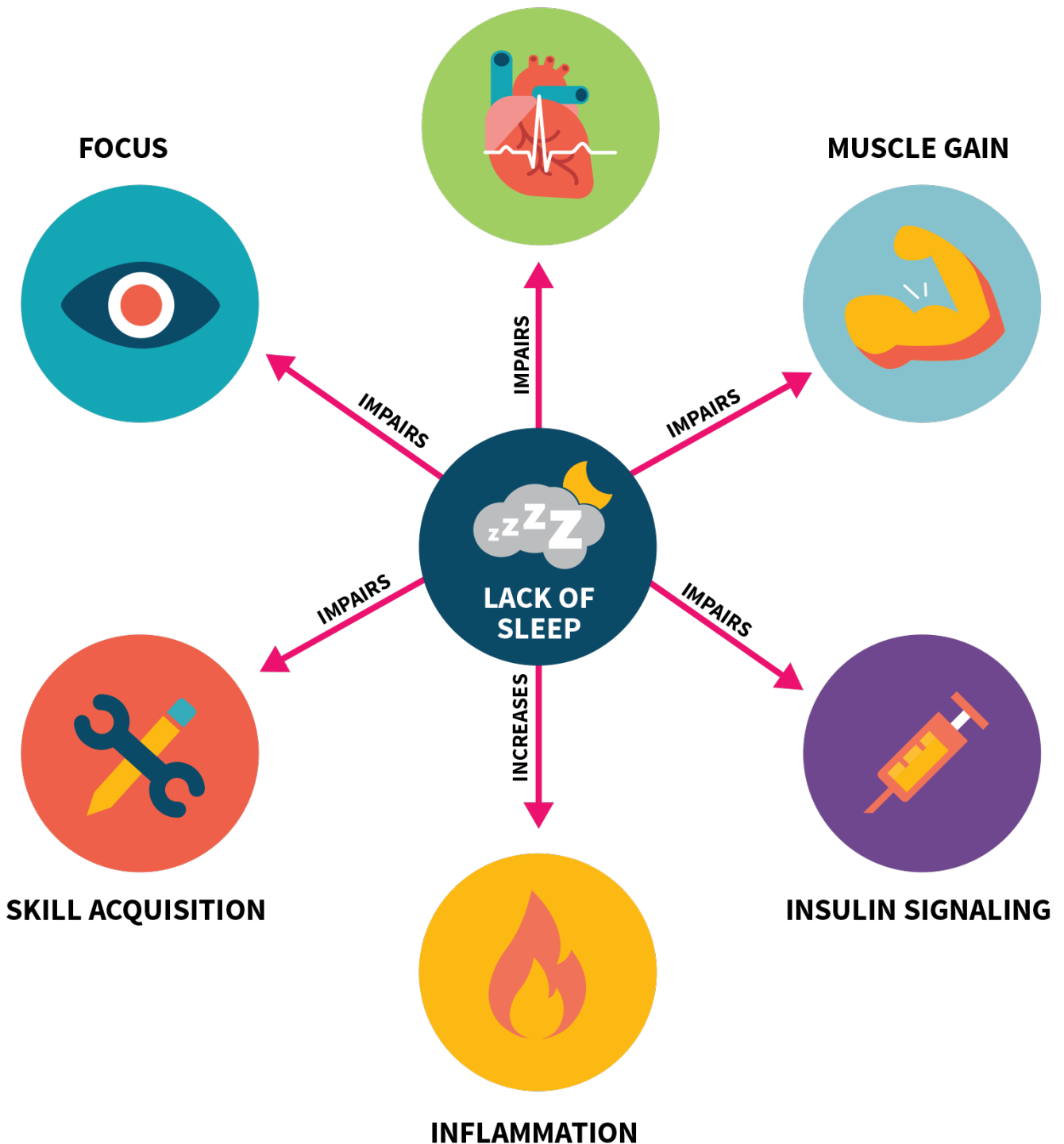
Lack of sleep can negatively affect every aspect of your life, including your general fitness. Lack of sleep impairs athletic performance, in both the short term^{[5][6]} and the long term, and it does so in several ways, with some more obvious than others:

- *Impaired skill acquisition.* Your ability to build specific brain-muscle connections (for example, to play the violin or throw a ball accurately) decreases with sleep deprivation, possibly due to a decrease in myelin production.^[7] Moreover, to build the *right* brain-muscle connections, you need to repeat the *right* moves, a task that becomes harder if your focus is impaired.

- *Impaired focus.*^[9] Problems in concentration affect not only mental tasks, such as taking an exam or planning a project, but also physical ones. You simply can't give your all if you're not really "there" when you train or compete.
- *Increased inflammation.*^{[9][10]} Not only does this lead to an increased risk of injury, but even low-level pain^[11] will worsen your mood, foster mental and physical fatigue (you'll tire out even sooner, at work and at play), and further impair your focus.
- *Impaired insulin signaling.* This leads to impaired glucose metabolism.^{[6][12][13][14][15]} Glucose, also known as blood sugar, is a main source of energy; if you cannot burn this fuel efficiently, you'll tire sooner (and risk developing diabetes,^{[16][17][18]} to boot).
- *Impaired cardiovascular health.* If you don't get enough sleep, you're at a higher risk for cardiovascular disease.^[19] Impaired glucose metabolism is one of the probable causes.
- *Impaired muscle gain.* You've probably heard that "you grow when you sleep". In truth, we're still not quite sure that more muscle is built during sleep than during waking hours, but we do know that lack of sleep impairs muscle gain.^[6] The reasons are complex; they include a decrease in testosterone production^{[20][21][22][23][24]} and, as we mentioned, an increase in fatigue (if you can't exercise as hard, or as long, you limit your potential for muscle growth).

How lack of sleep affects you

CARDIOVASCULAR HEALTH

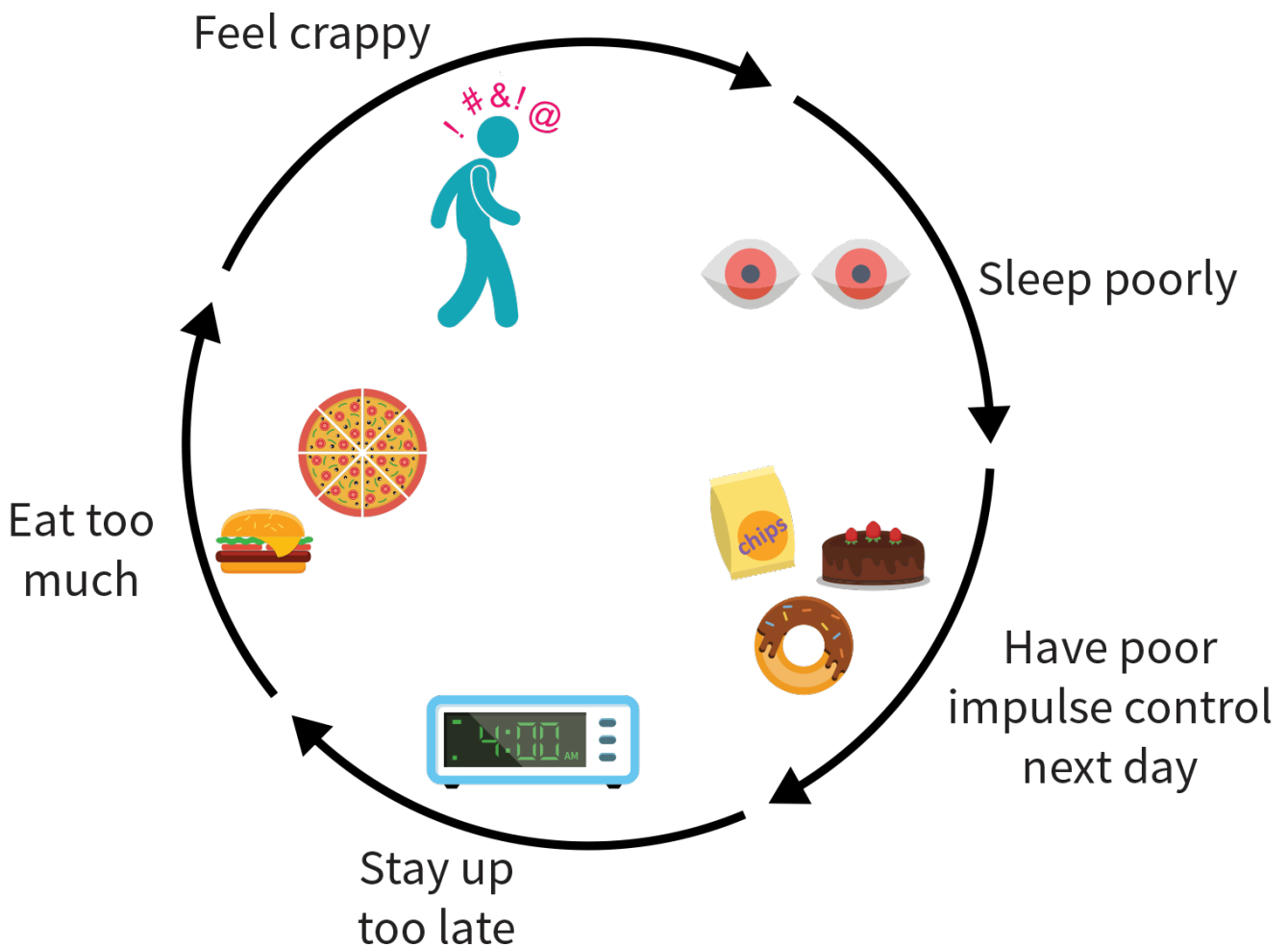


Wow. Is that all? Not quite. In addition to a decrease in athletic performance *per se*, lack of sleep also causes an **increase in fat gain**. And isn't *that* unfair? If you spend more time awake, shouldn't you burn more calories? And isn't burning more calories what *fat burning* is all about? So why does study after study show that [you gain fat as you lose sleep?](#)^[25]

The main reason is simple: as you sleep less, you eat more. Even partial [sleep deprivation](#) can cause a 20% increase in voluntary energy intake.^[15] It also causes your body to burn less fat and more muscle (which is yet another reason why lack of sleep impairs muscle growth).^[25]

Now I hope that all this bad news won't keep you awake at night, or I've just become part of the problem! There are two big reasons why people don't get enough sleep, and [stress](#) is one of them. The other reason is that many people simply don't schedule enough time for sleep on a daily basis, instead hoping to "catch up" during the weekend (a strategy with very limited efficacy). Other reasons, which are less widespread but harder to address, include [pain](#),^{[26][27]} [sleep apnea](#), and the forms of [insomnia](#) not related to stress.

Vicious cycle of staying up late and feeling crappy



The solutions

[So what can you do about it?](#) Let's be blunt: all a supplement can do is *help* you [fall asleep](#), *help* you [stay asleep](#), and *help* you [sleep better](#). No supplement is going to knock you out, and of course, no supplement will pack 8 hours of sleep into 5 hours.

If you want your sleep to improve, you'll have to work with your supplements, not against them. You won't like it, but here it is:

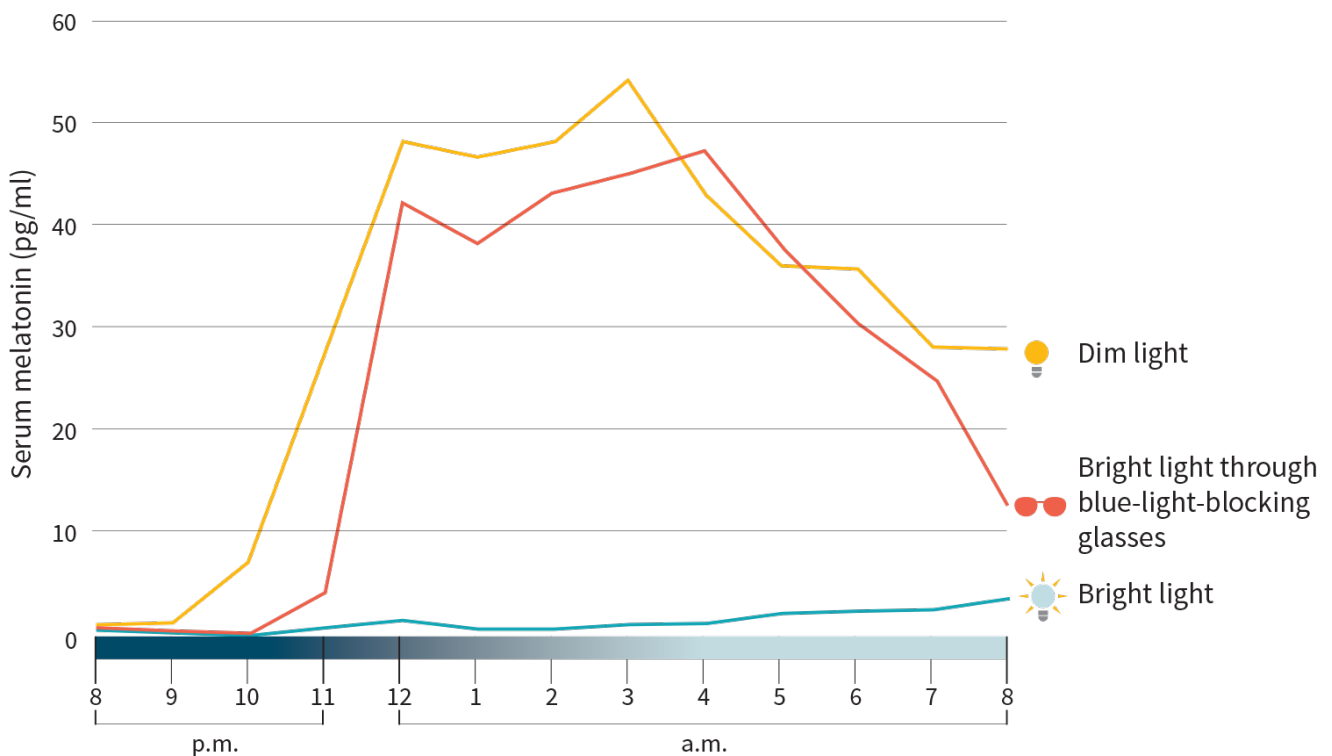
First, you need to schedule enough time for sleep each day.

Second, you should try going to bed at the same time every day, even during the weekend, because this habit both improves sleep quality and reduces sleep onset latency (i.e., the time it takes you to fall asleep).

Third, for at least 1 hour before bed, you need to relax and avoid sources of blue light.


Blue light (which is produced by most screens as well as by the sun) can keep you awake even after you turn it off; and even after you fall asleep, it can still reduce your body's production of [melatonin](#), thus decreasing the quality of your sleep.

Effect of light on melatonin production



Reference: Kayumov et al. *J Clin Endocrinol Metab.* 2005.^[26]

Because playing intense games and answering emails tend to stimulate your brain, those activities are less than ideal near bedtime. Still, if you really need to use your phone, tablet, or computer at night, consider using a program that reddens your screen light after sunset. Or, if you cannot easily adjust the color balance of your screen, start wearing [blue-light-blocking glasses](#) a couple of hours before bedtime.

 **Tip: What should you avoid doing before bed?**

If you ask people what they'd like to do before bed, you might hear answers such as meditate, read a book, or share some *special time* with their partner. But in reality, texting, playing games, or working is becoming more prevalent by the year, to the probable detriment of sleep quality.^[29]

Aside from fiendishly typing and checking social media, are there any other activities you should avoid to get a sound night's sleep?

Eating right before bed is often targeted as a sleep killer. But the evidence is more nuanced; in some people, consuming small amounts of food (such as a glass of milk or a small snack) can benefit sleep.^[30] Nighttime exercise is another frowned-upon activity, yet recent trial^[31] and survey^[32] evidence has shown a potential influence on sleep.

As it stands, more than what your pre-bed activities are, what's likely to hurt your sleep at that time is excess light exposure. The bright lights of a gym will have this effect, but so will using a tablet — a light-emitting device — rather than reading a printed book.^{[33][34]}

All set? Ok, after the eyes, let's focus on the ears. Noise can both reduce [sleep quality](#) and make it harder to [fall asleep](#),^{[35][36][37]} so minimize the noise in your bedroom. If that doesn't suffice, get earplugs, but keep in mind that earplugs attenuate high frequencies more than they do low frequencies — they may protect you against cars honking, but not much against traffic rumble.

Noise is bad enough, but heat can be worse.^[38] A bedroom warm enough to raise your core temperature can impair sleep quality and even cause [insomnia](#).^[39] Conversely, a bedroom cool enough to lower your core temperature (but not so chilly as to be uncomfortable) will help you fall asleep faster and enter the deeper stages of sleep sooner.^[40] An instinctive desire to reduce one's core temperature also explains why some people like to keep a foot outside the blanket (the hands and feet are especially good at dissipating body heat).

There you have it. If anything, supplementation should be considered a solution of last resort, reserved for people who cannot sufficiently improve their sleep through lifestyle changes. And even if supplements help you, do not feel that you have to take them daily: if their efficacy seems to wane as weeks go by, try taking them only 3 to 5 nights per week.

It may take you a couple of months to determine your optimal combination of supplements and a couple more months to ascertain your best supplementation schedule. Every few months afterward, consider pausing supplementation to determine whether your nonsupplemented sleep quality has improved.

10 Tips for better sleep

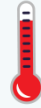
What can
HURT



Light



Noise



Heat



Alcohol



Caffeine

What can
HELP



Exercise



A consistent
sleeping schedule



Melatonin



Magnesium




Lavender

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

Combos

Disclaimer about supplement quality

We expect that readers will do their due diligence when choosing products. Depending on the manufacturer, supplements may have inaccurate labels (i.e., they contain too much or too little of the ingredients they claim, or in some cases, significant amounts of other ingredients not listed). They may also contain significant amounts of contaminants such as heavy metals or pesticides. It is also possible for supplements to contain ingredients that people are commonly allergic to, and it's important to be aware of the nonmedicinal ingredients as well. As a brief introduction to vetting manufacturers, we drew up [a short list of steps you should take](#) if a product has caught your interest.

 **Tip: Why don't you recommend brands or specific products?**


For two reasons:

- We don't test physical products. What our researchers do — all day, every day — is analyze peer-reviewed studies on supplements and nutrition.
- We go to great lengths to protect our integrity. As you've probably noticed, we don't sell supplements or even show ads from supplement companies, even though either option would generate a lot more money than our Supplement Guides ever will — and for a lot less work, too.

If we recommended any brands or specific products, our integrity would be called into question, so... we can't do it.

Core Combo

Start with 0.5 mg (500 µg) of [melatonin](#) half an hour before bed. You can increase by 0.5 mg each week until you find the lowest effective dose that works, but do not exceed 5 mg (5,000 µg). Melatonin can also help in case of [jet lag](#).

 **Tip: Try one combo alone for a few weeks**

Taking too many supplements all at once may prevent you from determining which ones are truly working. Start with just one of the combos suggested here for a couple of weeks before you consider making any modification, such as adding another supplement, altering a supplement dosage, or incorporating the supplements from an additional combo.

When adding another supplement to your regimen, be methodical. For example, you may want to take all the supplements from two combos. Select the combo that you wish to try first and take this for a couple of weeks. Then, add one supplement from the second combo and wait another week to see how it affects you. Continue this process until you've added all the supplements on your list.

If a supplement appears in two combos you wish to combine, don't stack the doses; instead, combine the ranges. For instance, if the range is 2–4 mg in one combo and 3–6 mg in the other, your new range becomes 2–6 mg. Always start with the lower end of the range — especially in this case, because the reason why one of the ranges has a lower ceiling in one combo may be due to a synergy with another supplement in the same combo. Reading through the full supplement entry may help you decide which dose to aim for, but if you're not sure, lower is usually safer.

Specialized Combos

For people with anxiety and intrusive thoughts

A healthy diet that provides sufficient nutrients and the aforementioned lifestyle changes are essential before taking more and more herbal supplements. If you have anxiety, it is highly recommended to seek treatment by a healthcare professional.

Once that is addressed, in addition to melatonin:

Take 80 mg of Silexan™ (a lavender oil preparation standardized for the active component linalool at 25%–46% of total weight) 30–45 minutes before bed. After 2 weeks, if no benefit has been observed, the dose can be increased to 160 mg (this is the *maximum* dose). Lavender can also be used as aromatherapy but is less reliable than the oral preparation.

If lavender oil proves insufficient on its own:

Add ashwagandha at a dose of 250 mg/day, split between two doses in the morning and evening (i.e., two doses of 125 mg each), and then increase to 600 mg/day if sleep doesn't improve noticeably after 2 weeks.

If the combination of lavender oil and ashwagandha proves to be insufficient on its own:

Take 600 mg of *Melissa officinalis*, powder on the first day, and slowly increase to 1,200 mg by the end of the first week. If that amount proves to be insufficient, higher doses may be helpful, but at this point, it is important to note that herbs can interact negatively with each other and with medications, and the more you take of the aforementioned herbs, the greater the theoretical risk becomes.

What has changed since the last time?

Changed position

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”. These changes have already been implemented for some guides, but this is the first update to the Sleep 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:

- L-theanine
- Ashwagandha
- L-tryptophan

Changed ranking:

Melatonin

Downgraded from primary to secondary. Although it is highly likely that melatonin can have a positive effect on sleep, the actual effects are generally small, and it may not help in some contexts.

Magnesium

Downgraded from secondary to unproven. Although the mechanistic plausibility is very high, and evidence is supportive, magnesium still has insufficient research according to our new standards.

Glycine

Downgraded from promising to unproven. Similar story to magnesium.

Valerian

Downgraded from promising to unproven. Although it is mechanistically plausible, the evidence is heavily mixed, and the best evidence generally suggests that if there is an effect, it is a small and unreliable one. Participants in studies do report better subjective sleep quality after taking it, but objective sleep measures don’t appear to be convincingly improved.

Outcomes/methods glossary

Sleep (onset) latency: the amount of time it takes to fall asleep after laying down with the intention to sleep imminently.

Sleep efficiency: the percentage of time spent sleeping while in bed.

Sleep duration: the amount of time spent sleeping

Sleep quality: can refer to a number of different measures of sleep, especially how restful sleep is.

Actigraphy: a method of objectively measuring activity during sleep using a device worn on the wrist.

Primary Supplements

There aren't any supplements that we know of that have a considerable benefit, a high degree of evidence, and are broadly applicable. The secondary and promising supplements in this guide either lack robust evidence or are more likely to have modest effects on average.

Secondary Supplements

Lavender

What makes *lavender* a secondary supplement

Lavender (*Lavandula*) is used in [aromatherapy](#) for its relaxing scent. Because of the difficulty of blinding in aromatherapy studies, a lot of the evidence for lavender's effects stems from lower-quality studies, but newer studies have examined oral supplementation to treat anxiety.

Intrusive thoughts can increase the [time it takes to fall asleep](#); lavender can reduce anxiety,^[41] promote relaxation, and have a calming effect on the mind.^{[42][43][44]} Lavender may also improve sleep quality,^{[45][46][47][48]} and alleviate insomnia,^{[45][46]} though more research is needed to determine the mechanism behind this effect. Similarly, more research is needed to confirm whether lavender and [lemon balm](#) are synergistic.

Studies on oral supplementation are more recent, and most of them used a proprietary lavender extract. In people with anxiety, Silexan™ was shown to alleviate anxiety^{[49][50][51][52]} and improve sleep quality and duration.^[52]

Common methods of lavender administration

CAPSULES



MASSAGE OIL



INHALED OIL



Warnings about lavender

Trials on lavender for anxiety have found a possible link to infections, headaches, palpitations, and gastrointestinal adverse events.^[41] However, none of these events were serious and the frequency wasn't very high, making it difficult to pin them on lavender. More research from longer and larger trials is needed to establish lavender's safety.

Lavender may have hormonal effects. [The Endocrine Society](#) and the [National Institutes of Health](#) warn that there is some evidence that lavender oil has estrogenic properties and can cause [gynecomastia](#) (enlarged breasts in men and boys).

Three case studies of prepubertal gynecomastia have previously been attributed to topical administration of a cologne with lavender as an ingredient.^{[53][54]} More recently, a case-series reported three prepubertal girls and one boy with clinical evidence of estrogenic action associated with a history of using lavender-

based fragrance.^[55] Although the precise development of these conditions can be multifactorial, the gynecomastia resolved once the use of the products was discontinued. Additionally, there is *in vivo* evidence of the estrogenic and antiandrogenic properties of both lavender and tea tree essential oils.^[54]

If you are using lavender and your breasts become tender, cease use immediately.

Lavender can cause drowsiness. For this reason, it is important to understand how lavender affects you before driving, operating dangerous equipment, or doing anything else where a lack of focus could be hazardous. This effect may be compounded and especially dangerous if lavender is combined with medications such as benzodiazepines that also can have such side effects.

How to take *lavender*

Take 80 mg of Sillexan™ (a lavender oil preparation standardized for the active component linalool at 25%–46% of total weight) 30–45 minutes before bed. After two weeks, if no benefit has been observed, the dose can be increased to 160 mg (this is the *maximum* dose).

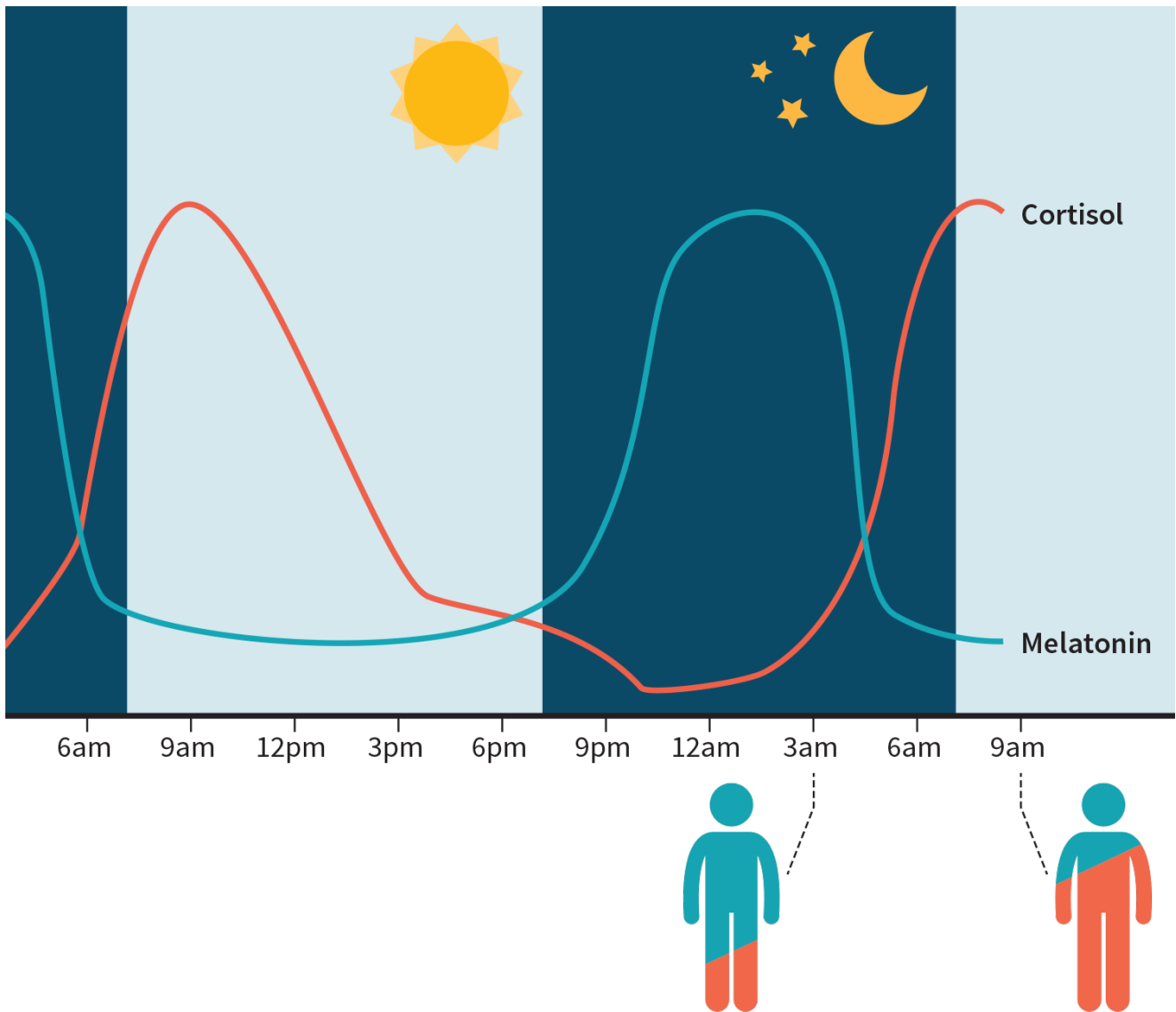
Lavender oil is also used in aromatherapy — burned as a candle, heated, placed in a vaporizer, or added to a hot bath. The number of variables (product concentration, proximity of the user to the source, size of the room, etc.) makes recommending dosages exceedingly difficult, but studies have used at least 30 minutes of exposure in a well-ventilated room either at night or in the afternoon.

Melatonin

What makes *melatonin* a secondary supplement

Melatonin is a hormone involved in the [circadian rhythm](#) (which dictates sleeping and waking cycles). As you wake up in the morning, melatonin levels go down, while at night, or if you dim the lights, melatonin production increases.

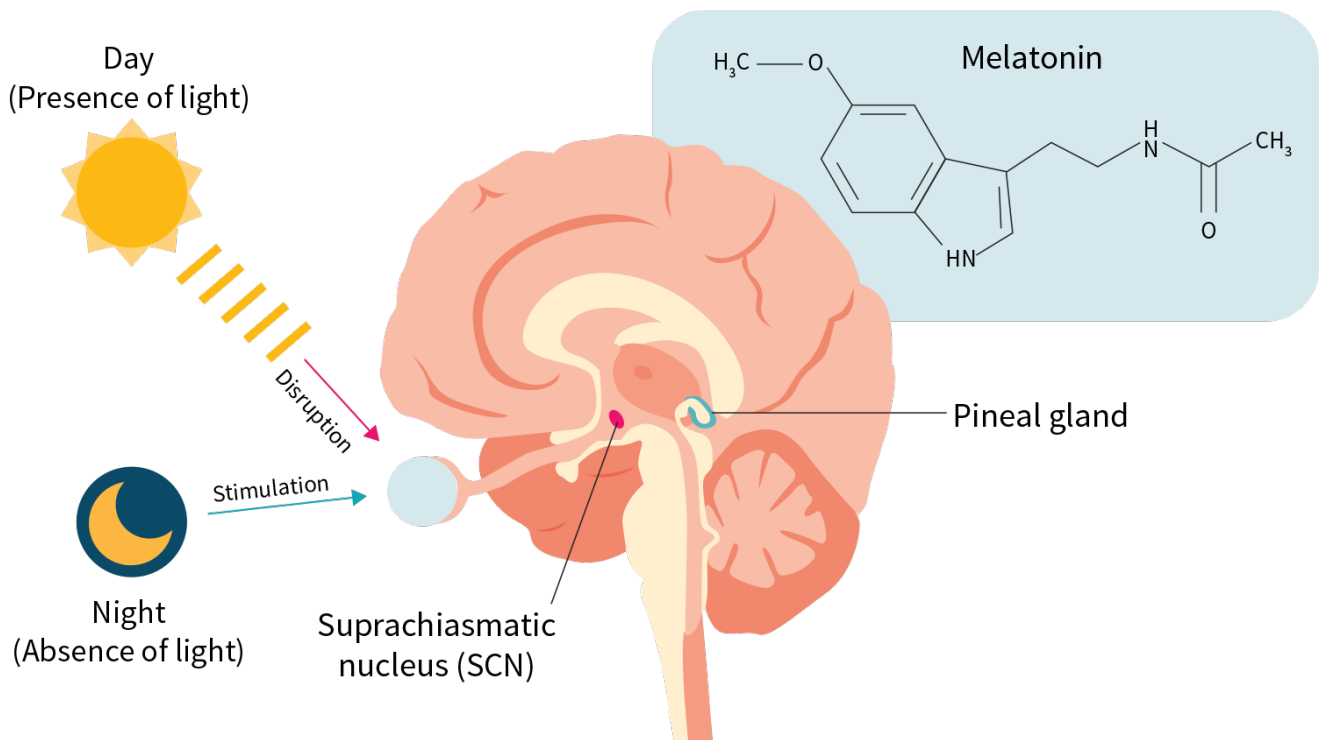
Variation in melatonin and cortisol throughout the day



Your circadian rhythm doesn't exist in a vacuum — it's influenced by external cues, which are referred to as *zeitgebers* (German for "time givers"). Light is one of these zeitgebers. It impacts our circadian rhythm through its interaction with blue light receptors in the retina and the neural pathways that they influence.

Melatonin is one of the primary controllers of our body's circadian rhythm and is produced in the brain, specifically in the pineal gland in the absence of blue-wavelength light (shown below).^[56] Therefore, the production of melatonin can be disrupted by exposure to artificial light after sunset, leading to disruptions in circadian rhythms and sleep problems.^[57]

The effect of light on melatonin production



Reference: Hardeland et al. *Int J Biochem Cell Biol.* 2006.^[56]

When administered as a supplement, melatonin can induce phase shifts in the circadian timing system and advance sleep onset.^[56] It can also reduce core body temperature, which encourages sleep. Consequently, oral melatonin most notably improves sleep onset latency in people with primary (i.e., a sleep disorder not caused by medical or psychiatric conditions or substance abuse) and secondary sleep disorders.^{[59][60][61]} However, although a statistically significant effect of melatonin is consistently observed across different populations, it's unclear whether this reduction in sleep onset latency is *clinically meaningful* because most reviews on the topic report an improvement in the range of about 3–15 minutes.^[62] For other sleep outcomes, melatonin supplementation has been found to improve overall sleep quality as measured by the Pittsburgh Sleep Quality Index (–1.24 points on average) in adults with various diseases.^[63] Further analysis revealed that although the effect was significant in people with respiratory or metabolic diseases or sleep disorders, it was nonsignificant in people with neurodegenerative diseases and other conditions.

Evidence also suggests that melatonin may increase total sleep time, but this effect is inconsistent. In studies that have reported an increase in total sleep time, the results have varied from around 7 to 50 minutes, depending on the population studied and how the outcome was measured (i.e., subjective measures like questionnaire vs. objective measures like polysomnography).^[62] Improvements appear to be more likely and of a larger magnitude in the context of secondary insomnia compared to primary insomnia.^{[64][61]}

Warnings about melatonin

Although it is generally safe, melatonin may cause dizziness, headaches, nausea, and sleepiness/drowsiness in some people.^[65]

The sleepiness/drowsiness may be particularly relevant for anyone who may be awoken from their sleep to perform difficult or dangerous tasks (e.g., firefighters).

In one study, 1 out of 23 participants taking melatonin to adapt to night-shift work reported nightmares/vivid dreams shortly after beginning melatonin supplementation.^[66] This effect may be an overlooked adverse event due to the lack of specific inquiry into it, or the tendency to forget dreams shortly upon awakening, and it is plausible due to melatonin's effects on REM sleep. However, more specific evidence is needed to determine whether this effect is frequent.

Rumor has it that melatonin can decrease testosterone levels in men. However, this suspicion is still based on *in vitro* and/or rodent data.^{[67][68]} Researchers emphasize that the effects can be time dependent and, most importantly, species dependent.^[69] In fact, when evidence from human studies is considered, the notion that melatonin supplements could lead to significant reductions of testosterone levels in males appears unwarranted — even when higher doses of melatonin (e.g. 6 mg/day taken at 5 p.m.) are consumed daily for 4 weeks, the testosterone secretion of healthy adult men is not affected.^{[70] [71][72]}

How to take *melatonin*

As little as 0.3 mg of oral melatonin has been found to produce supraphysiological levels of melatonin in the body,^[73] which suggests that this may be considered as a minimally effective dose. Start with 0.3 mg (300 µg) taken 1 hour before bed and increase by 0.5 mg each week until a maximally effective dose is reached. Many studies have administered doses as high as 10 mg/day, but it's unlikely that this high of a dose is needed or is superior to lower doses. In a review of studies featuring adults with various diseases, >3 mg/day of melatonin was found to be superior to <3 mg/day, and immediate release was better than prolonged release.^[63]

Promising Supplements

Ashwagandha

What makes *ashwagandha* a promising supplement

Ashwagandha is an herb found across India and South Asia and has a rich history of use in Ayurveda as an adaptogen (i.e., herbs that improve the response to stress) and for treatment of a variety of ailments. Today, it is most widely known for its anti-anxiety effects, and emerging evidence suggests that it could be useful for improving sleep as well.

Although the exact mechanism by which ashwagandha improves sleep is currently unknown, one study in mice suggested that it may induce sleep by acting on the [GABA](#) receptor,^[74] and another reported that triethylene glycol could be the active sleep-inducing component of ashwagandha.^[75]

Several trials have assessed the efficacy of ashwagandha to improve outcomes related to sleep quality, featuring different populations and measurements, but the results have been relatively consistent across the board. Ashwagandha improved subjective sleep quality measured on a 7-point Likert scale in adults with “good sleep” at baseline,^[76] adults with “poor sleep” and elevated stress levels at baseline,^[77] and older adults (ages 65–80) with “poor” sleep at baseline.^[78]

The effects of ashwagandha on sleep quality have also been investigated using more objective measures (i.e., actigraphy). In people with diagnosed insomnia and mild to moderate anxiety, ashwagandha has been shown to improve various measures of sleep quality, including greater increases in sleep efficiency as well as decreases in sleep onset latency and wake after sleep onset compared to placebo.^{[76][79]} Additionally, ashwagandha was found to prolong total sleep time, boost sleep efficiency, and reduce sleep onset latency and wake after sleep onset in people with nonrestorative sleep.^[80]

Collectively, the available evidence suggests that ashwagandha has a medium positive effect on overall sleep, sleep onset latency, and sleep efficiency and a small positive effect on total sleep time and wake after sleep onset, with larger effects in people with diagnosed insomnia.^[81]

As a result of a small sample size, heterogeneity in the baseline sleep quality of participants, and the use of objective measures of sleep quality in only 3 trials, ashwagandha is a promising supplement for improving sleep quality, but more research is needed to draw strong conclusions about its magnitude of effect in specific populations.

Warnings about *ashwagandha*

Ashwagandha continues to show promising evidence for its efficacy and safety. Mild side effects of drowsiness, upper GI discomfort, dizziness, and loose stools have been reported with the use of ashwagandha.^[82] Because ashwagandha may increase testosterone levels,^[83] it is possible that it could be an issue in individuals with [hormone-sensitive prostate cancer](#). However, the reported increase in testosterone is well within the normal daily fluctuation of 30% to 35% in healthy men, so the risk may not be particularly significant.^[84] In fact, one of ashwagandha’s main active ingredients, Withaferin A, has anticancer effects in

various cancer cell lines, including prostate cells, where it interferes directly with the initiation and progression of cancerous growth.^[85] Therefore, it's not immediately clear whether it would be detrimental even in the context of hormone-sensitive prostate cancer. Ashwagandha's hormonal effects could raise concern about its use during pregnancy, but the evidence on its safety is mostly old, sparse, and unclear.^[86] Given the lack of evidence around this specific use, it's safest to avoid ashwagandha while pregnant or breastfeeding. There have also been case reports illustrating the potential of ashwagandha to cause [liver injury](#).^[87] [Benzodiazepines](#), [anticonvulsants](#), and [barbiturates](#) may be dangerous to take with ashwagandha because these drugs have sedative characteristics, and taking ashwagandha along with them can increase these effects.^[82]

How to take *ashwagandha*

The most common dosing protocol is to take 300 mg twice per day (600 mg total). One study found that as little as 250 mg/day (split between two doses of 125 mg) was sufficient to improve subjective sleep quality, but it was inferior to 600 mg/day.^[77] Based on these findings, it may be best to start with 250 mg/day and then increase to 600 mg/day if sleep doesn't improve noticeably.

Melissa officinalis

What makes *Melissa officinalis* a promising supplement

Melissa officinalis ([lemon balm](#)) appears to have a meaningful effect on anxiety, with the current evidence suggesting a notable reduction.^[88] Anxiety is a major contributor to sleep difficulties, prolonging the amount of time it takes to fall asleep and causing excessive waking.

The number of trials evaluating its effects on sleep is still small, but the 4 available trials show consistent benefits to overall sleep quality, and 1 trial demonstrated the ability to reduce the time it takes to fall asleep (sleep onset latency).^{[89][90][91][92]} Only one of the trials was in participants with clear sleep disturbances not related to a parent condition, so there's very little evidence to support it for general insomnia, but the research that we have looks promising, especially for people with anxiety-influenced sleep issues.

Warnings about *Melissa officinalis*

Unlike benzodiazepines ([diazepam](#)/Valium, [alprazolam](#)/Xanax, [clonazepam](#)/Klonopin), lemon balm is not potent enough to have addictive or habit-forming properties. Nevertheless, any supplement with a sedative effect can disrupt [working memory](#) and reduce [attention](#) span. *Do not drive or operate heavy machinery after taking lemon balm or any other supplement with a sedative effect. Do not take lemon balm during the day.* Combining lemon balm with medications that cause sedation or drowsiness may be especially dangerous.

One case study reported withdrawal symptoms after discontinuing lemon balm in a 30-year-old who had been suffering from anxiety. It is unclear whether this supplement was truly the cause, though it may be

wise to be cautious during discontinuation.^[93]

How to take *Melissa officinalis*

Take 1,200–3,000 mg of lemon balm powder 30–60 minutes before bed. Start with 600 mg; ramp up to 1200 mg over the course of a week if no lower dose proves effective. Only take a dose larger than 1,200 mg if it provides noticeably greater benefits.

Lemon balm is also used in [aromatherapy](#), but studies tend to examine oral supplementation because it is a more reliable delivery method.

Unproven Supplements

Glycine

What makes *glycine* an unproven supplement

Glycine is an amino acid that's most prominent in collagen, but it is used in many other proteins and biological functions. With relevance to sleep, it acts as a neurotransmitter to NMDA receptors, which can lead to vasodilation and a reduction in body temperature, thus facilitating better sleep.^[94]

In one randomized, single-blind crossover trial, 11 healthy participants took 3 grams of glycine at 1 hour before bedtime or a placebo for two nights and underwent sleep testing.^[95] The participants generally reported greater subjective sleep satisfaction, with less difficulty getting to sleep, less time awake and more time sleeping, though the subjective questionnaire appeared to be limited by selective reporting. The researchers did find an improvement in sleep onset latency, though not in time until REM sleep or sleep architecture overall. There was a reduction in daytime sleepiness, but it was not statistically significant for most time points, and there may have been some small cognitive improvements. Overall, this study should be considered very preliminary.

In a randomized, double-blind crossover trial, 19 participants also took 3 grams of glycine or placebo before bedtime for 4 days and experienced improvements in fatigue and subjective sleep satisfaction when taking glycine, but this trial was quite preliminary as well.^[96]

Finally, in a randomized, single-blind crossover trial, 10 participants underwent partial sleep restriction (25% lower than their usual sleeping time).^[97] When taking glycine, the participants reported less fatigue and sleepiness (the latter was not statistically significant, however). There were some possible improvements in cognitive function, but the only statistically significant finding was improvement in reaction time on the psychomotor vigilance test on both testing days. The researchers also performed a rat study and found higher nighttime plasma melatonin levels in rats that took glycine.

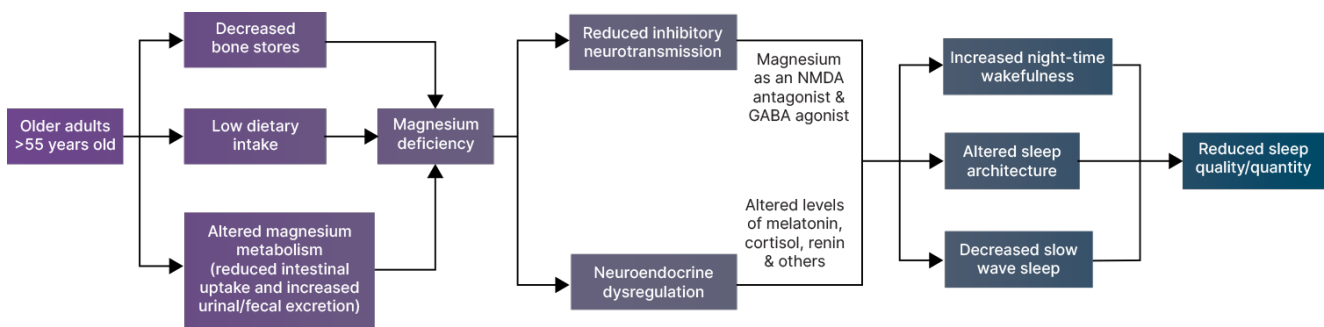
In summary, glycine looks promising, but the amount and quality of the research we currently have is insufficient, and it remains unproven.

Magnesium

What makes *magnesium* an unproven supplement

[Magnesium](#) is an essential dietary mineral, and is the second most prevalent electrolyte in the human body. It is a cofactor for over 300 enzymatic reactions and plays an important role in the brain by controlling neuron excitability. Evidence pertaining to the efficacy of magnesium supplementation for improving sleep

quality is scarce, but mechanistically, low magnesium levels can lead to abnormal neuronal excitation (i.e., cells are activated during periods when they are not intentionally activated) and subsequently impair sleep. It's speculated that magnesium's role in regulating sleep is related to its ability to act as an antagonist and agonist of the NMDA and GABA systems.^{[98][99]}



Most people do not consume enough magnesium, and this is especially true in Western countries where diets are rich in refined foods that are poor in magnesium. In older adults, the risk of magnesium deficiency is enhanced, not only due to alterations in food choices that lead to a reduced intake^[100] but also as a product of reduced intestinal uptake and increased urinary excretion of magnesium.^[101] Additionally, a variety of medications (e.g., diuretics, proton pump inhibitors) can exacerbate magnesium losses, and it is common for older adults to take multiple medications to manage their health. As a consequence, older adults have been the population of interest for use of supplemental magnesium to improve sleep quality.

Collectively, *very limited* evidence suggests that magnesium supplementation may have a small positive effect on sleep onset latency (-17 minutes) in older adults.^[102] Also, one study reported that magnesium supplementation improved slow-wave sleep.^[98] However, it's critical to highlight that the studies conducted so far have been low quality and at moderate to high risk of bias.

As it stands, there is insufficient evidence to support magnesium as a sleep supplement. Nevertheless, magnesium is very cheap and widely available, and it is lacking in the average diet. For these reasons, if magnesium intake through foods is insufficient, supplementation may be recommended. Subjective improvements in sleep quality as a result may be a bonus. But for people with sufficient magnesium levels who consume a magnesium-rich diet, supplementing with magnesium is unlikely to improve sleep quality.

Digging Deeper: Who is more likely to have low magnesium levels?

- *Older people*, because they tend to have relatively low magnesium intakes^[100] and may absorb less during digestion.^[103]
- *People who sweat a lot*, because magnesium is lost through sweat. Athletes participating in sports requiring weight control may be especially vulnerable.
- *People with type 2 diabetes*, because according to estimates for all adult ages in developed countries, hypomagnesemia affects less than 15% of healthy people but up to 50% of people with type 2 diabetes.^[104]

L-Theanine

What makes *L-theanine* an unproven supplement

Theanine, an amino acid found in green tea, regulates neurotransmission, and the results are often a reduction in stress and increase in relaxation.^[105] Because stress is a common cause of impaired sleep, theanine may be of use for sleep disorders.

However, the evidence is simply too preliminary to declare theanine an effective method of improving sleep quality. Three randomized trials have been conducted, and overall, they suggest a modest benefit to overall sleep.^{[106][107][108]} However, the trials weren't specifically designed to properly test theanine for improving sleep, and the overall evidence remains weak. There are 2 supportive open-label studies, but they don't add very much to the evidence due to their nonrigorous designs.^{[105][109]}

Tryptophan

What makes *tryptophan* an unproven supplement

L-Tryptophan is an essential amino acid found in meat, dairy, some seeds and nuts, fish, green leafy vegetables, and eggs. Given its important role in the production of serotonin and melatonin — compounds that are essential for the body's sleep-wake cycle — tryptophan has been studied as a potential therapeutic for improving sleep quality. However, the evidence from the available randomized controlled trials examining these potential effects have produced mixed results.

More specifically, according to the results of a 2021 meta-analysis of 4 randomized controlled trials involving 135 adults, supplementation with L-tryptophan improved wake time after sleep onset by around 1 minute, but failed to improve total sleep time, sleep latency (the time it takes a person to fall asleep), or sleep efficiency (the percentage of time spent asleep while in bed).^[110]

It's worth noting that, in the aforementioned meta-analysis, L-tryptophan supplementation improved sleep latency (by around 50 seconds) and sleep efficiency (by around 1.6%) in sensitivity analyses that removed one trial conducted in participants without insomnia. These results suggest that supplementation with L-tryptophan is more likely to improve sleep quality in individuals with insomnia.

With the above said, the size of the potential effect seems to be very small. It's also worth keeping in mind that these results were based on only a few small trials (3–4 in the main analyses and 2 in the sensitivity analyses). For these reasons, tryptophan is considered an unproven supplement.

Valerian

What makes *valerian* an unproven supplement

The root of valerian (*Valeriana officinalis*) has a long history of use as a treatment for insomnia and was one of the first sleep aids on the market. However, the available randomized controlled trials examining the effectiveness of valerian for improving sleep have produced mostly mixed results.

More specifically, a 2015 meta-analysis of 7 randomized controlled trials reported no effects of valerian on

sleep latency (the time it takes a person to fall asleep), duration, efficiency, or quality.^[111] Most of the trials included in the meta-analysis used 400–600 mg of valerian root extract taken 1 hour before sleep. Similarly, a 2010 meta-analysis found no effects of valerian on sleep latency or sleep quality measured using a visual analogue scale.^[112] However, when the researchers examined dichotomous sleep quality (where participants were asked whether valerian improved their sleep quality or not), they found that participants taking valerian were 37% more likely to report improved sleep quality compared to participants taking a placebo. It's worth noting, though, that when this analysis was restricted to high-quality trials, the results became statistically nonsignificant.

In all, it may be the case that differences in the formulation of the supplement may affect its efficacy. This idea is supported by the results of a 2020 meta-analysis, which found that valerian whole root, but not valerian root extract, improved subjective sleep quality.^[113] However, it should be kept in mind that only 4 trials were included in this analysis.

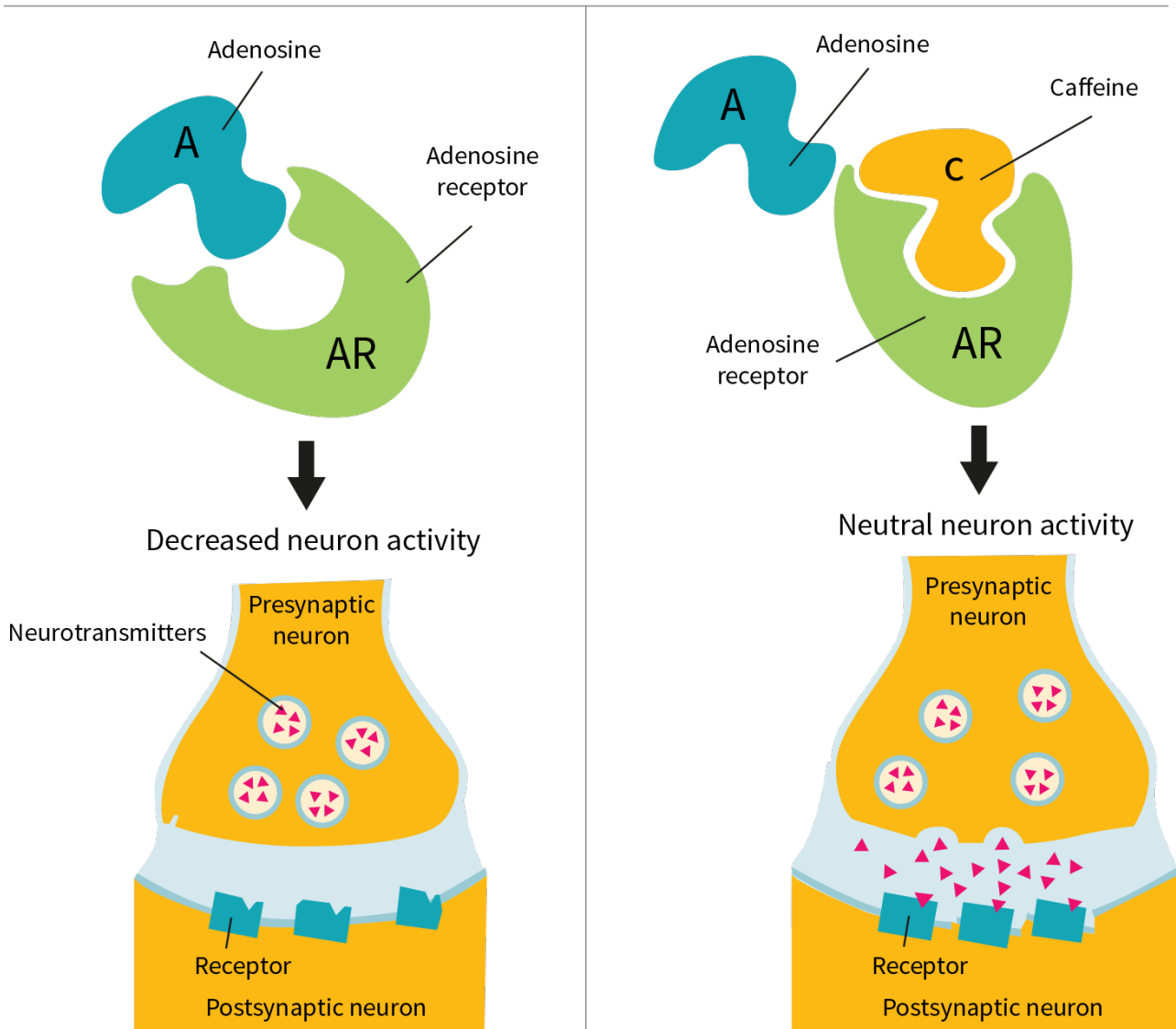
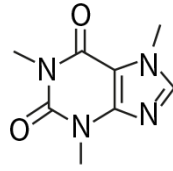
Inadvisable Supplements

Caffeine

What makes *caffeine* an inadvisable supplement

Caffeine's primary mechanism of action, shown in the figure below, is interference with the effects of a molecule called adenosine.^[114] Adenosine promotes sleepiness by binding to certain receptors in the brain and interferes with the release of neurotransmitters that are associated with wakefulness, such as dopamine. Caffeine disrupts this process by preventing the binding of adenosine to its receptors, thus allowing the normal release of neurotransmitters associated with wakefulness.

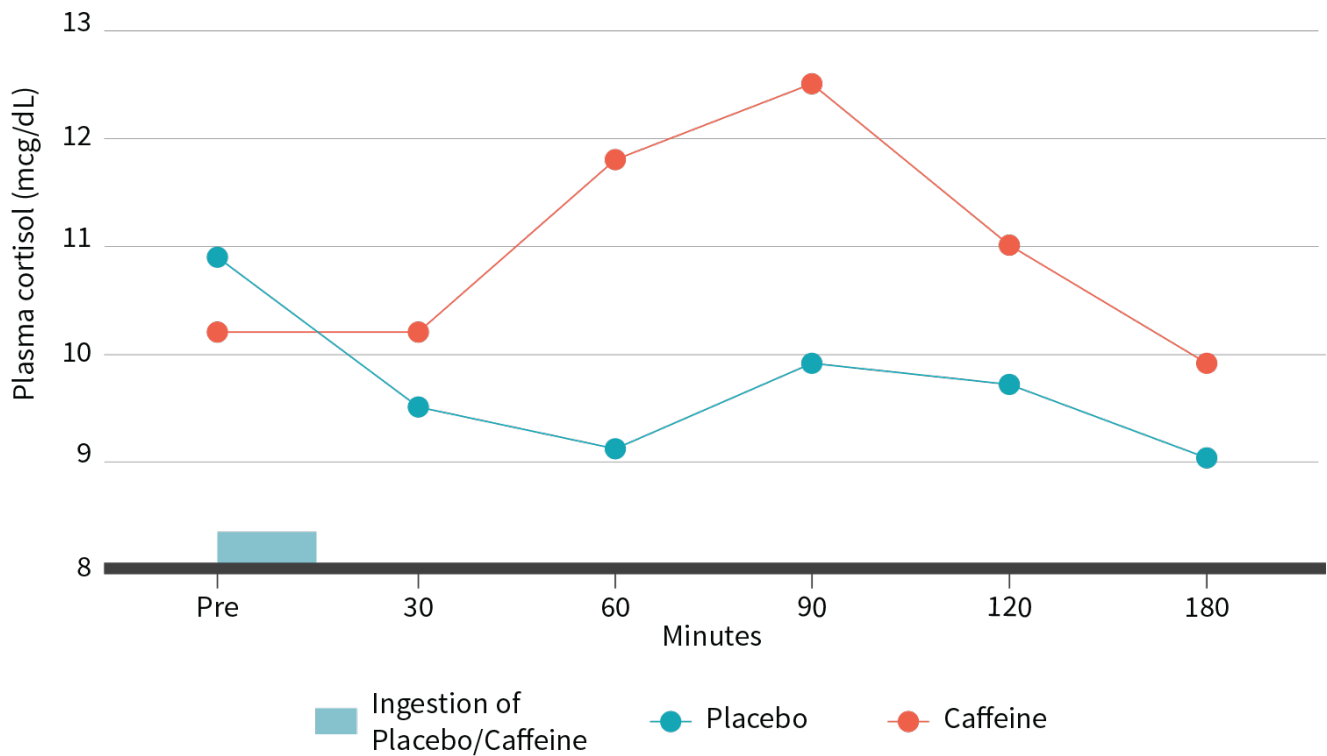
The mechanism of caffeine



Reference: Ferré. *J Neurochem.* 2008.^[114]

People with a caffeine tolerance may still be able to fall asleep after ingesting caffeine, but this stimulant will still negatively affect sleep onset latency and sleep quality.^[115] Caffeine should not be consumed before sleep even by the most veteran coffee drinkers. Although some studies suggest that caffeine paired with 15–30-minute “power naps” can benefit alertness more than caffeine or naps alone, this benefit does not extend to longer sleep durations because caffeine will cause cortisol levels to rise after about 30 minutes.

Effects of caffeine on cortisol levels

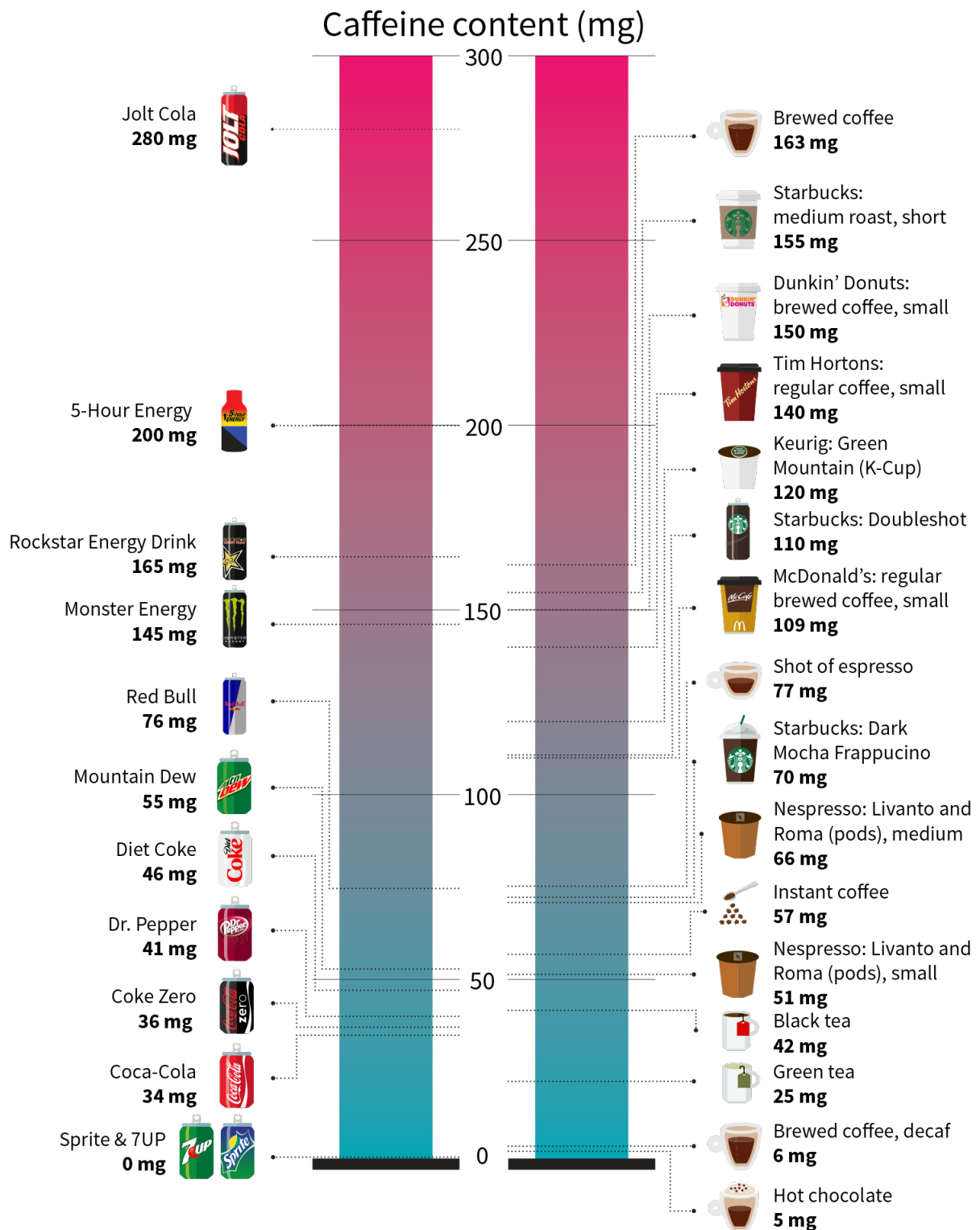


Reference: Lovallo et al. *Pharmacol Biochem Behav.* 1996.^[116]

You might already be consuming more caffeine than you think. When calculating daily caffeine intake, consider all [beverages](#), foods, and supplements consumed. Bear in mind that caffeine can be “hidden” in a product — for instance, if “[guarana seeds](#)” is listed on a label, remember that those are richer in caffeine than coffee seeds.

Avoid caffeine at least 6 hours before bed.

Caffeine content of popular drinks



References: McCusker et al. *J Anal Toxicol.* 2006.^[117] ● Desbrow et al. *Nutr Health.* 2019.^[118] ● Ludwig et al. *Food Funct.* 2014.^[119] ● Fox et al. *J Agric Food Chem.* 2013.^[120] ● McCusker et al. *J Anal Toxicol.* 2003.^[121] ● Angeloni et al. *Food Res Int.* 2019.^[122]

Stimulants

What makes *stimulants* an inadvisable

supplement

People with sleep issues or those trying to improve sleep quality should be aware of the stimulants they may be taking (supplement or drugs) and when they take them.

If taking a stimulant, respect the recommended dosage. Be aware that most fat burners, preworkout supplements, [energy drinks](#), or other products marketed at “energy-boosting” are likely to contain stimulants, such as [caffeine](#) or [synephrine](#). Be especially careful when taking several such products because they may have cumulative or even synergistic effects (and side effects).

As a general rule of thumb, avoid taking any stimulants at least 6 hours before bed.

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 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 such as citrate, gluconate, or glycinate

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

"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. How does alcohol affect my sleep?

At first, [alcohol](#) can help you fall asleep, but this effect fades off after a few days if you keep drinking close to bedtime.^[123] And right from the start, it will impair the [quality of your sleep](#).^{[124][125]} Ironically, alcohol-use disorders have even been linked to [insomnia](#), though their being cause or consequence is uncertain.^[123]

In short, don't use alcohol as a sleep aid — it might help you relax, but it will impair the quality of your sleep. You may find it beneficial to avoid alcohol after dinner.

Q. Is melatonin supplementation safe?

In a review of 195 reviews of [melatonin](#) (i.e., an umbrella review), only 5.6% reported adverse effects and most of these effects were mild symptoms, such as [dizziness](#), [nausea](#), [headaches](#), and [fatigue](#).^[126] In some studies, pharmacological doses as high as 75 milligrams have been used without any serious adverse effects being reported.^[127] It is worth noting, however, that there aren't many long-term studies that have been conducted on melatonin.

There are, however, two things that should be kept in mind: First, a recent study found that many melatonin supplements do not meet the label claims.^[128] Second, some of the supplements that were tested in this study were contaminated with [serotonin](#), a neurotransmitter, that may affect the study results.

Q. Will supplementing melatonin affect my own production of melatonin?

It seems unlikely with low doses. Studies that have administered [melatonin](#) at doses of 0.5 milligrams,^[129] 2.0 milligrams,^[130] 5.0 milligrams,^[131] and 50 milligrams^[129] have found no significant effect on the body's ability to produce a basal level of melatonin.

Q. Are there specific species of lavender that have more active constituents?

[Lavender](#) is a plant from the *Lamiaceae* family that includes various different species. Most lavender species share similar major chemical constituents, consisting of terpenes, alcohols, ketones, and polyphenols.^[132] While constituents and properties are similar among species, lavender essential oil extracts can range from 26–57% [linalool](#) and 4–35% [linalyl acetate](#),^[133] with linalool considered the primary active constituent.^[134]

Q. How much sleep should I get?

How much sleep *you* need may take some trial-and-error testing to see what works best. But if you're looking for some general guidelines, check out the recommendations from the National Sleep Foundation below.^[135]

Recommended hours of sleep

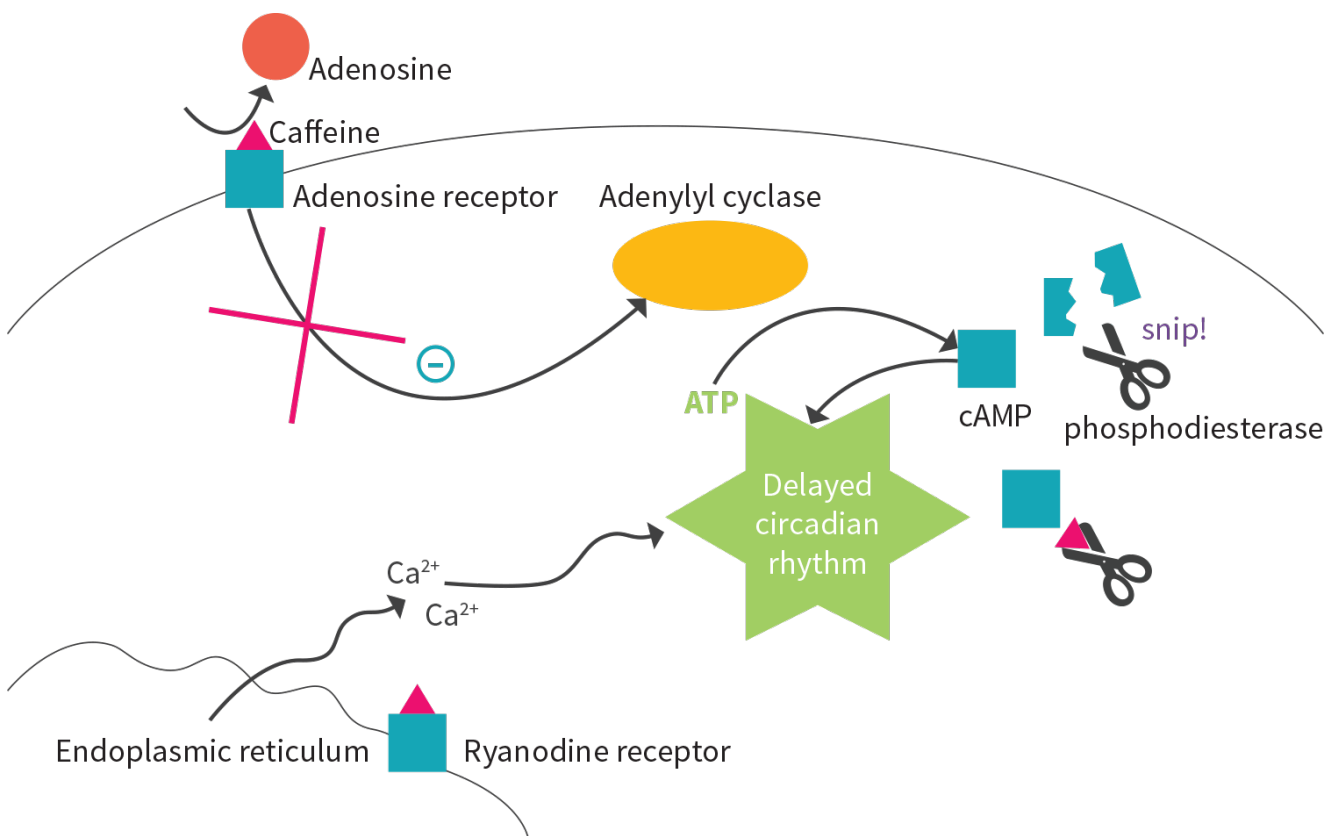
AGE	RECOMMENDED	MAY BE APPROPRIATE	NOT RECOMMENDED
0–3 months	14–17	11–19	<11 or >19
4–11 months	12–15	10–18	<10 or >18
1–2 years	11–14	9–16	<9 or >16
3–5 years	10–13	8–14	<8 or >14
6–13 years	9–11	7–12	<7 or >12
14–17 years	8–10	7–11	<7 or >11
18–25 years	7–9	6–11	<6 or >11
26–64 years	7–9	6–10	<6 or >10
≥65 years	7–8	5–9	<5 or >9

Adapted from Hirshkowitz et al. *Sleep Health*. 2015. [\[135\]](#)

Q. How exactly might caffeine screw up my circadian rhythm?

The [circadian clock](#) in humans is controlled primarily by the suprachiasmatic nucleus (SCN) within the brain. The SCN is a group of cells that sit by the optic nerve and respond to light and other stimuli that come in from the eye. Hypothetically, [caffeine](#) could affect the SCN (and other tissues throughout the body) in various ways, depicted below.

Possible ways caffeine could affect circadian rhythm



One way is through increasing a cell's levels of cyclic AMP ([cAMP](#)), which is often created inside a cell in response to a signal. This occurs for two reasons. First, caffeine blocks adenosine receptors that normally reduce cAMP levels. Second, caffeine binds phosphodiesterase enzymes that act to degrade cAMP.^[136] When these enzymes are blocked, cAMP levels are raised.

It's also been shown that circadian rhythms within the SCN are regulated in part by the release of calcium ions during the stimulation of ryanodine receptors,^[137] which caffeine also binds.^[138]

References

1. Su S, Baroody FM, Kohrman M, Suskind D [A comparison of polysomnography and a portable home sleep study in the diagnosis of obstructive sleep apnea syndrome](#). *Otolaryngol Head Neck Surg*. (2004 Dec)
2. Shrivastava D, Jung S, Saadat M, Sirohi R, Crewson K [How to interpret the results of a sleep study](#). *J Community Hosp Intern Med Perspect*. (2014 Nov 25)
3. Bhat S, Ferraris A, Gupta D, Mozafarian M, DeBari VA, Gushway-Henry N, Gowda SP, Polos PG, Rubinstein M, Seidu H, Chokroverty S [Is There a Clinical Role For Smartphone Sleep Apps? Comparison of Sleep Cycle Detection by a Smartphone Application to Polysomnography](#). *J Clin Sleep Med*. (2015 Jul 15)
4. de Zambotti M, Goldstone A, Claudatos S, Colrain IM, Baker FC [A validation study of Fitbit Charge 2™ compared with polysomnography in adults](#). *Chronobiol Int*. (2018 Apr)
5. Mah CD, Mah KE, Kezirian EJ, Dement WC [The effects of sleep extension on the athletic performance of collegiate basketball players](#). *Sleep*. (2011 Jul 1)
6. VanHelder T, Radomski MW [Sleep deprivation and the effect on exercise performance](#). *Sports Med*. (1989 Apr)
7. Bellesi M, Pfister-Genskow M, Maret S, Keles S, Tononi G, Cirelli C [Effects of sleep and wake on oligodendrocytes and their precursors](#). *J Neurosci*. (2013 Sep 4)
8. Alhola P, Polo-Kantola P [Sleep deprivation: Impact on cognitive performance](#). *Neuropsychiatr Dis Treat*. (2007)
9. Mullington JM, Simpson NS, Meier-Ewert HK, Haack M [Sleep loss and inflammation](#). *Best Pract Res Clin Endocrinol Metab*. (2010 Oct)
10. Simpson N, Dinges DF [Sleep and inflammation](#). *Nutr Rev*. (2007 Dec)
11. Haack M, Sanchez E, Mullington JM [Elevated inflammatory markers in response to prolonged sleep restriction are associated with increased pain experience in healthy volunteers](#). *Sleep*. (2007 Sep)
12. Broussard JL, Ehrmann DA, Van Cauter E, Tasali E, Brady MJ [Impaired insulin signaling in human adipocytes after experimental sleep restriction: a randomized, crossover study](#). *Ann Intern Med*. (2012 Oct 16)
13. Buxton OM, Pavlova M, Reid EW, Wang W, Simonson DC, Adler GK [Sleep restriction for 1 week reduces insulin sensitivity in healthy men](#). *Diabetes*. (2010 Sep)
14. Donga E, van Dijk M, van Dijk JG, Biermasz NR, Lammers GJ, van Kralingen KW, Corssmit EP, Romijn JA [A single night of partial sleep deprivation induces insulin resistance in multiple metabolic pathways in healthy subjects](#). *J Clin Endocrinol Metab*. (2010 Jun)
15. Bosy-Westphal A, Hinrichs S, Jauch-Chara K, Hitze B, Later W, Wilms B, Settler U, Peters A, Kiosz D, Muller MJ [Influence of partial sleep deprivation on energy balance and insulin sensitivity in healthy women](#). *Obes Facts*. (2008)
16. Cappuccio FP, D'Elia L, Strazzullo P, Miller MA [Quantity and quality of sleep and incidence of type 2 diabetes: a systematic review and meta-analysis](#). *Diabetes Care*. (2010 Feb)
17. Beihl DA, Liese AD, Haffner SM [Sleep duration as a risk factor for incident type 2 diabetes in a multiethnic cohort](#). *Ann Epidemiol*. (2009 May)
18. Chaput JP, Després JP, Bouchard C, Astrup A, Tremblay A [Sleep duration as a risk factor for the development of type 2 diabetes or impaired glucose tolerance: analyses of the Quebec Family Study](#). *Sleep Med*. (2009 Sep)
19. Nagai M, Hoshida S, Kario K [Sleep duration as a risk factor for cardiovascular disease- a review of the recent literature](#). *Curr Cardiol Rev*. (2010 Feb)
20. Cote KA, McCormick CM, Geniole SN, Renn RP, MacAulay SD [Sleep deprivation lowers reactive aggression and testosterone in men](#). *Biol Psychol*. (2013 Feb)
21. Leproult R, Van Cauter E [Effect of 1 week of sleep restriction on testosterone levels in young healthy men](#). *JAMA*. (2011 Jun 1)
22. Penev PD [Association between sleep and morning testosterone levels in older men](#). *Sleep*. (2007 Apr)
23. González-Santos MR, Gajá-Rodríguez OV, Alonso-Urriarte R, Sojo-Aranda I, Cortés-Gallegos V [Sleep deprivation and adaptive hormonal responses of healthy men](#). *Arch Androl*. (1989)
24. Cortés-Gallegos V, Castañeda G, Alonso R, Sojo I, Carranco A, Cervantes C, Parra A [Sleep deprivation reduces circulating androgens in healthy men](#). *Arch Androl*. (1983 Mar)
25. Nedeltcheva AV, Kilkus JM, Imperial J, Schoeller DA, Penev PD [Insufficient sleep undermines dietary efforts to reduce adiposity](#). *Ann Intern Med*. (2010 Oct 5)
26. Sasaki E, Tsuda E, Yamamoto Y, Maeda S, Inoue R, Chiba D, Okubo N, Takahashi I, Nakaji S, Ishibashi Y [Nocturnal knee pain increases with the severity of knee osteoarthritis, disturbing patient sleep quality](#). *Arthritis Care Res (Hoboken)*. (2014 Jul)
27. Blay SL, Andreoli SB, Gastal FL [Chronic painful physical conditions, disturbed sleep and psychiatric morbidity: results from an elderly survey](#). *Ann Clin Psychiatry*. (2007 Jul-Sep)
28. Kayumov L, Casper RF, Hawa RJ, Perelman B, Chung SA, Sokalsky S, Shapiro CM [Blocking low-wavelength light prevents nocturnal melatonin suppression with no adverse effect on performance during simulated shift work](#). *J Clin Endocrinol Metab*.

(2005 May)

29. Whipples J, Byra M, Gerow KG, Hill Guseman E [Evaluation of Nighttime Media Use and Sleep Patterns in First-semester College Students](#). *Am J Health Behav*. (2018 May 1)
30. Kinsey AW, Ormsbee MJ [The health impact of nighttime eating: old and new perspectives](#). *Nutrients*. (2015 Apr 9)
31. Flausino NH, Da Silva Prado JM, de Queiroz SS, Tufik S, de Mello MT [Physical exercise performed before bedtime improves the sleep pattern of healthy young good sleepers](#). *Psychophysiology*. (2012 Feb)
32. Buman MP, Phillips BA, Youngstedt SD, Kline CE, Hirshkowitz M [Does nighttime exercise really disturb sleep? Results from the 2013 National Sleep Foundation Sleep in America Poll](#). *Sleep Med*. (2014 Jul)
33. Grønli J, Byrkjedal IK, Bjorvatn B, Nødtvedt Ø, Hamre B, Pallesen S [Reading from an iPad or from a book in bed: the impact on human sleep. A randomized controlled crossover trial](#). *Sleep Med*. (2016 May)
34. Chang AM, Aeschbach D, Duffy JF, Czeisler CA [Evening use of light-emitting eReaders negatively affects sleep, circadian timing, and next-morning alertness](#). *Proc Natl Acad Sci U S A*. (2015 Jan 27)
35. Basner M, Brink M, Bristow A, de Kluizenaar Y, Finegold L, Hong J, Janssen SA, Klaeboe R, Leroux T, Liebl A, Matsui T, Schwela D, Sliwiska-Kowalska M, Sörqvist P [ICBEN review of research on the biological effects of noise 2011-2014](#). *Noise Health*. (2015 Mar-Apr)
36. Halperin D [Environmental noise and sleep disturbances: A threat to health?](#). *Sleep Sci*. (2014 Dec)
37. Hume KI, Brink M, Basner M [Effects of environmental noise on sleep](#). *Noise Health*. (2012 Nov-Dec)
38. Libert JP, Bach V, Johnson LC, Ehrhart J, Wittersheim G, Keller D [Relative and combined effects of heat and noise exposure on sleep in humans](#). *Sleep*. (1991 Feb)
39. Lack LC, Gradisar M, Van Someren EJ, Wright HR, Lushington K [The relationship between insomnia and body temperatures](#). *Sleep Med Rev*. (2008 Aug)
40. Murphy PJ, Campbell SS [Nighttime drop in body temperature: a physiological trigger for sleep onset?](#). *Sleep*. (1997 Jul)
41. Donelli D, Antonelli M, Bellinazzi C, Gensini GF, Firenzuoli F [Effects of lavender on anxiety: A systematic review and meta-analysis](#). *Phytomedicine*. (2019 Dec)
42. Sayorwan W, Siripornpanich V, Piriyaapunyaporn T, Hongratanaworakit T, Kotchabhakdi N, Ruangrunsi N [The effects of lavender oil inhalation on emotional states, autonomic nervous system, and brain electrical activity](#). *J Med Assoc Thai*. (2012 Apr)
43. Tiffany Field, Tory Field, Christy Cullen, Shay Largie, Miguel Diego, Saul Schanberg, Cynthia Kuhn [Lavender bath oil reduces stress and crying and enhances sleep in very young infants](#). *Early Hum Dev*. (2008 Jun)
44. J Lehrner, G Marwinski, S Lehr, P Jöhren, L Deecke [Ambient odors of orange and lavender reduce anxiety and improve mood in a dental office](#). *Physiol Behav*. (2005 Sep 15)
45. Inn-Sook Lee, Gyung-Joo Lee [Effects of lavender aromatherapy on insomnia and depression in women college students](#). *Taehan Kanho Hakhoe Chi*. (2006 Feb)
46. George T Lewith, Anthony Dean Godfrey, Philip Prescott [A single-blinded, randomized pilot study evaluating the aroma of *Lavandula augustifolia* as a treatment for mild insomnia](#). *J Altern Complement Med*. (2005 Aug)
47. Chien LW, Cheng SL, Liu CF [The effect of lavender aromatherapy on autonomic nervous system in midlife women with insomnia](#). *Evid Based Complement Alternat Med*. (2012)
48. Namni Goel, Hyungsoo Kim, Raymund P Lao [An olfactory stimulus modifies nighttime sleep in young men and women](#). *Chronobiol Int*. (2005)
49. Kasper S, Müller WE, Volz HP, Möller HJ, Koch E, Dienel A [Silexan in anxiety disorders: Clinical data and pharmacological background](#). *World J Biol Psychiatry*. (2018 Sep)
50. Kasper S, Anghelescu I, Dienel A [Efficacy of orally administered Silexan in patients with anxiety-related restlessness and disturbed sleep--A randomized, placebo-controlled trial](#). *Eur Neuropsychopharmacol*. (2015 Nov)
51. Kasper S, Gastpar M, Müller WE, Volz HP, Möller HJ, Schläfke S, Dienel A [Lavender oil preparation Silexan is effective in generalized anxiety disorder--a randomized, double-blind comparison to placebo and paroxetine](#). *Int J Neuropsychopharmacol*. (2014 Jun)
52. Kasper S, Gastpar M, Müller WE, Volz HP, Möller HJ, Dienel A, Schläfke S [Silexan, an orally administered *Lavandula oil* preparation, is effective in the treatment of 'subsyndromal' anxiety disorder: a randomized, double-blind, placebo controlled trial](#). *Int Clin Psychopharmacol*. (2010 Sep)
53. Diaz A, Luque L, Badar Z, Kornic S, Danon M [Prepubertal gynecomastia and chronic lavender exposure: report of three cases](#). *J Pediatr Endocrinol Metab*. (2016 Jan)
54. Henley DV, Lipson N, Korach KS, Bloch CA [Prepubertal gynecomastia linked to lavender and tea tree oils](#). *N Engl J Med*. (2007 Feb 1)
55. Ramsey JT, Li Y, Arao Y, Naidu A, Coons LA, Diaz A, Korach KS [Lavender Products Associated With Premature Thelarche and Prepubertal Gynecomastia: Case Reports and Endocrine-Disrupting Chemical Activities](#). *J Clin Endocrinol Metab*. (2019 Nov 1)
56. Hardeland R, Pandi-Perumal SR, Cardinali DP [Melatonin](#). *Int J Biochem Cell Biol*. (2006 Mar)

57. Gooley JJ, Chamberlain K, Smith KA, Khalsa SB, Rajaratnam SM, Van Reen E, Zeitzer JM, Czeisler CA, Lockley SW [Exposure to room light before bedtime suppresses melatonin onset and shortens melatonin duration in humans. *J Clin Endocrinol Metab.* \(2011 Mar\)](#)
58. Arendt J, Skene DJ [Melatonin as a chronobiotic. *Sleep Med Rev.* \(2005-Feb\)](#)
59. Fiona Auld, Emily L Maschauer, Ian Morrison, Debra J Skene, Renata L Riha [Evidence for the efficacy of melatonin in the treatment of primary adult sleep disorders. *Sleep Med Rev.* \(2017 Aug\)](#)
60. Sha Wei, Marcel G Smits, Xiangdong Tang, Li Kuang, Huaqing Meng, Shifen Ni, Mingzhao Xiao, Xinyu Zhou [Efficacy and Safety of Melatonin for Sleep Onset Insomnia in Children and Adolescents: A Meta-Analysis of Randomized Controlled Trials. *Sleep Med.* \(2020 Apr\)](#)
61. Tian Li, Shuai Jiang, Mengzhen Han, Zhi Yang, Jianjun Lv, Chao Deng, Russel J Reiter, Yang Yang [Exogenous melatonin as a treatment for secondary sleep disorders: A systematic review and meta-analysis. *Front Neuroendocrinol.* \(2019 Jan\)](#)
62. Low TL, Choo FN, Tan SM [The efficacy of melatonin and melatonin agonists in insomnia - An umbrella review. *J Psychiatr Res.* \(2020-Feb\)](#)
63. Gholami Fatemeh, Moradi Sajjad, Rasaei Niloufar, Soveid Neda, Setayesh Leila, Mirzaei Khadijeh [Effect of melatonin supplementation on sleep quality: a systematic review and meta-analysis of randomized controlled trials. *J Neurol.* \(2021 Jan 8\)](#)
64. Braam W, Smits MG, Didden R, Korzilius H, Van Geijlswijk IM, Curfs LM [Exogenous melatonin for sleep problems in individuals with intellectual disability: a meta-analysis. *Dev Med Child Neurol.* \(2009-May\)](#)
65. Andersen LP, Gögenur I, Rosenberg J, Reiter RJ [The Safety of Melatonin in Humans. *Clin Drug Investig.* \(2016-Mar\)](#)
66. Cavallo A, Ris MD, Succop P, Jaskiewicz J [Melatonin treatment of pediatric residents for adaptation to night shift work. *Ambul Pediatr.* \(2005\)](#)
67. Valenti S, Giusti M [Melatonin participates in the control of testosterone secretion from rat testis: an overview of our experience. *Ann N Y Acad Sci.* \(2002-Jun\)](#)
68. Qin F, Zhang J, Zan L, Guo W, Wang J, Chen L, Cao Y, Shen O, Tong J [Inhibitory effect of melatonin on testosterone synthesis is mediated via GATA-4/SF-1 transcription factors. *Reprod Biomed Online.* \(2015-Nov\)](#)
69. Yu K, Deng SL, Sun TC, Li YY, Liu YX [Melatonin Regulates the Synthesis of Steroid Hormones on Male Reproduction: A Review. *Molecules.* \(2018-Feb-17\)](#)
70. Luboshitzky R, Levi M, Shen-Orr Z, Blumenfeld Z, Herer P, Lavie P [Long-term melatonin administration does not alter pituitary-gonadal hormone secretion in normal men. *Hum Reprod.* \(2000-Jan\)](#)
71. F Waldhauser, H R Lieberman, H J Lynch, M Waldhauser, K Herkner, H Frisch, H Vierhapper, W Waldhäusl, M Schemper, R J Wurtman [A pharmacological dose of melatonin increases PRL levels in males without altering those of GH, LH, FSH, TSH, testosterone or cortisol. *Neuroendocrinology.* \(1987 Aug\)](#)
72. Besag FMC, Vasey MJ, Lao KSJ, Wong ICK [Adverse Events Associated with Melatonin for the Treatment of Primary or Secondary Sleep Disorders: A Systematic Review. *CNS Drugs.* \(2019-Dec\)](#)
73. Vural EM, van Munster BC, de Rooij SE [Optimal dosages for melatonin supplementation therapy in older adults: a systematic review of current literature. *Drugs Aging.* \(2014-Jun\)](#)
74. Bhattarai JP, Ah Park S, Han SK [The methanolic extract of *Withania somnifera* ACTS on GABAA receptors in gonadotropin releasing hormone \(GnRH\) neurons in mice. *Phytother Res.* \(2010-Aug\)](#)
75. Kaushik MK, Kaul SC, Wadhwa R, Yanagisawa M, Urade Y [Triethylene glycol, an active component of Ashwagandha \(*Withania somnifera*\) leaves, is responsible for sleep induction. *PLoS One.* \(2017\)](#)
76. Deepak Langade, Vaishali Thakare, Subodh Kanchi, Sunil Kelgane [Clinical evaluation of the pharmacological impact of ashwagandha root extract on sleep in healthy volunteers and insomnia patients: A double-blind, randomized, parallel-group, placebo-controlled study. *J Ethnopharmacol.* \(2020 Aug 17\)](#)
77. Salve J, Pate S, Debnath K, Langade D [Adaptogenic and Anxiolytic Effects of Ashwagandha Root Extract in Healthy Adults: A Double-blind, Randomized, Placebo-controlled Clinical Study. *Cureus.* \(2019 Dec 25\)](#)
78. Sunil B Kelgane, Jaysing Salve, Prasanthi Sampara, Khokan Debnath [Efficacy and Tolerability of Ashwagandha Root Extract in the Elderly for Improvement of General Well-being and Sleep: A Prospective, Randomized, Double-blind, Placebo-controlled Study. *Cureus.* \(2020 Feb 23\)](#)
79. Langade D, Kanchi S, Salve J, Debnath K, Ambegaokar D [Efficacy and Safety of Ashwagandha \(*Withania somnifera*\) Root Extract in Insomnia and Anxiety: A Double-blind, Randomized, Placebo-controlled Study. *Cureus.* \(2019 Sep 28\)](#)
80. Abhijit Deshpande, Nushafreen Irani, Ratna Balkrishnan, Irin Rosanna Benny [A randomized, double blind, placebo controlled study to evaluate the effects of ashwagandha \(*Withania somnifera*\) extract on sleep quality in healthy adults. *Sleep Med.* \(2020 Mar 21\)](#)
81. Kae Ling Cheah, Mohd Noor Norhayati, Lili Husniati Yaacob, Razlina Abdul Rahman [Effect of Ashwagandha \(*Withania somnifera*\) extract on sleep: A systematic review and meta-analysis. *PLoS One.* \(2021 Sep 24\)](#)
82. Tandon N, Yadav SS [Safety and clinical effectiveness of *Withania Somnifera* \(Linn.\) Dunal root in human ailments. *J Ethnopharmacol.* \(2020-Jun-12\)](#)
83. Adrian L Lopresti, Peter D Drummond, Stephen J Smith [A Randomized, Double-Blind, Placebo-Controlled, Crossover Study Examining the Hormonal and Vitality Effects of Ashwagandha \(*Withania somnifera*\) in Aging, Overweight Males. *Am J Mens*](#)

84. Brambilla DJ, Matsumoto AM, Araujo AB, McKinlay JB [The effect of diurnal variation on clinical measurement of serum testosterone and other sex hormone levels in men..](#) *J Clin Endocrinol Metab.* (2009-Mar)
85. Dutta R, Khalil R, Green R, Mohapatra SS, Mohapatra S [\(Ashwagandha\) and Withaferin A: Potential in Integrative Oncology..](#) *Int J Mol Sci.* (2019-Oct-25)
86. Gardner Z, McGuffin M, Upton R, et al. [American Herbal Products Association's Botanical Safety Handbook, 2nd Edition.](#)
87. Björnsson HK, Björnsson ES, Avula B, Khan IA, Jonasson JG, Ghabril M, Hayashi PH, Navarro V [Ashwagandha-induced liver injury: A case series from Iceland and the US Drug-Induced Liver Injury Network..](#) *Liver Int.* (2020-Apr)
88. Javid Ghazizadeh, Saeed Sadigh-Eteghad, Wolfgang Marx, Ali Fakhari, Sanaz Hamedeyazdan, Mohammadali Torbati, Somaiyeh Taheri-Tarighi, Mostafa Araj-Khodaei, Mojgan Mirghafourvand [The effects of lemon balm \(Melissa officinalis L.\) on depression and anxiety in clinical trials: A systematic review and meta-analysis.](#) *Phytother Res.* (2021 Aug 27)
89. Habib Haybar, Ahmad Zare Javid, Mohammad Hosein Haghighizadeh, Einollah Valizadeh, Seyede Marjan Mohaghegh, Assieh Mohammadzadeh [The effects of Melissa officinalis supplementation on depression, anxiety, stress, and sleep disorder in patients with chronic stable angina.](#) *Clin Nutr ESPEN.* (2018 Aug)
90. Heydari N, Dehghani M, Emamghoreishi M, Akbarzadeh M [Effect of Melissa officinalis capsule on the mental health of female adolescents with premenstrual syndrome: a clinical trial study.](#) *Int J Adolesc Med Health.* (2018 Jan 25)
91. Soltanpour A, Alijaniha F, Naseri M, Kazemnejad, Heidari M [Effects of Melissa officinalis on anxiety and sleep quality in patients undergoing coronary artery bypass surgery: A double-blind randomized placebo controlled trial.](#) *Eur J Integr Med.* (2019 June)
92. Aliakbari F, Rafieian M [The Effectiveness of Melissa officinalis on Sleep Problem in Patients with Chronic Heart Failure.](#) *J Pharm Negat.* (2018)
93. Kadir Demirci, Mehmet Akgönül, Arif Demirdaş, Abdullah Akpınar [Does melissa officinalis cause withdrawal or dependence?.](#) *Med Arch.* (2015 Feb)
94. Kawai N, Sakai N, Okuro M, Karakawa S, Tsuneyoshi Y, Kawasaki N, Takeda T, Bannai M, Nishino S [The sleep-promoting and hypothermic effects of glycine are mediated by NMDA receptors in the suprachiasmatic nucleus..](#) *Neuropsychopharmacology.* (2015-May)
95. Yamadera W, Inagawa K, Chiba S, Bannai M, Takahashi M, Nakayama Kazuhiko [Glycine ingestion improves subjective sleep quality in human volunteers, correlating with polysomnographic changes.](#) *Sleep Biol Rhythms.* (2007 March)
96. Inagawa K, Hiraoka T, Kohda T, Yamadera W, Takahashi M [Subjective effects of glycine ingestion before bedtime on sleep quality.](#) *Sleep Biol Rhythms.* (2006 Feb)
97. Bannai M, Kawai N, Ono K, Nakahara K, Murakami N [The effects of glycine on subjective daytime performance in partially sleep-restricted healthy volunteers.](#) *Front Neurol.* (2012 Apr 18)
98. Held K, Antonijevic IA, Künzel H, Uhr M, Wetter TC, Golly IC, Steiger A, Murck H [Oral Mg\(2+\) supplementation reverses age-related neuroendocrine and sleep EEG changes in humans.](#) *Pharmacopsychiatry.* (2002 Jul)
99. Murck H, Steiger A [Mg2+ reduces ACTH secretion and enhances spindle power without changing delta power during sleep in men -- possible therapeutic implications..](#) *Psychopharmacology (Berl).* (1998-Jun)
100. Ford ES, Mokdad AH [Dietary magnesium intake in a national sample of US adults.](#) *J Nutr.* (2003 Sep)
101. Barbagallo M, Belvedere M, Dominguez LJ [Magnesium homeostasis and aging..](#) *Magnes Res.* (2009-Dec)
102. Jasmine Mah, Tyler Pitre [Oral magnesium supplementation for insomnia in older adults: a Systematic Review & Meta-Analysis.](#) *BMC Complement Med Ther.* (2021 Apr 17)
103. Musso CG [Magnesium metabolism in health and disease.](#) *Int Urol Nephrol.* (2009)
104. Pham PC, Pham PM, Pham SV, Miller JM, Pham PT [Hypomagnesemia in patients with type 2 diabetes.](#) *Clin J Am Soc Nephrol.* (2007 Mar)
105. Shinsuke Hidese, Miho Ota, Chisato Wakabayashi, Takamasa Noda, Hayato Ozawa, Tsutomu Okubo, Hiroshi Kunugi [Effects of chronic L-theanine administration in patients with major depressive disorder: an open-label study.](#) *Acta Neuropsychiatr.* (2017 Apr)
106. Shinsuke Hidese, Shintaro Ogawa, Miho Ota, Ikki Ishida, Zenta Yasukawa, Makoto Ozeki, Hiroshi Kunugi [Effects of L-Theanine Administration on Stress-Related Symptoms and Cognitive Functions in Healthy Adults: A Randomized Controlled Trial.](#) *Nutrients.* (2019 Oct 3)
107. Sarris J, Byrne GJ, Cribb L, Oliver G, Murphy J, Macdonald P, Nazareth S, Karamacoska D, Galea S, Short A, Ee C, Birling Y, Menon R, Ng CH [L-theanine in the adjunctive treatment of generalized anxiety disorder: A double-blind, randomised, placebo-controlled trial.](#) *J Psychiatr Res.* (2019 Mar)
108. Lyon MR, Kapoor MP, Juneja LR [The effects of L-theanine \(Suntheanine®\) on objective sleep quality in boys with attention deficit hyperactivity disorder \(ADHD\): a randomized, double-blind, placebo-controlled clinical trial.](#) *Altern Med Rev.* (2011 Dec)
109. Ota M, Wakabayashi C, Sato N, Hori H, Hattori K, Teraishi T, Ozawa H, Okubo T, Kunugi H [Effect of L-theanine on glutamatergic function in patients with schizophrenia..](#) *Acta Neuropsychiatr.* (2015-Oct)
110. Clarinda N Sutanto, Wen Wei Loh, Jung Eun Kim [The impact of tryptophan supplementation on sleep quality: a systematic review, meta-analysis, and meta-regression.](#) *Nutr Rev.* (2021 May 3)

111. Leach MJ, Page AT [Herbal medicine for insomnia: A systematic review and meta-analysis.](#) *Sleep Med Rev.* (2015-Dec)
112. Fernández-San-Martín MI, Masa-Font R, Palacios-Soler L, Sancho-Gómez P, Calbó-Caldentey C, Flores-Mateo G [Effectiveness of Valerian on insomnia: a meta-analysis of randomized placebo-controlled trials.](#) *Sleep Med.* (2010 Jun)
113. Shinjyo N, Waddell G, Green J [Valerian Root in Treating Sleep Problems and Associated Disorders-A Systematic Review and Meta-Analysis.](#) *J Evid Based Integr Med.* (2020)
114. Ferré S [An update on the mechanisms of the psychostimulant effects of caffeine.](#) *J Neurochem.* (2008 May)
115. Clark I, Landolt HP [Coffee, caffeine, and sleep: A systematic review of epidemiological studies and randomized controlled trials.](#) *Sleep Med Rev.* (2017 Feb)
116. Lovallo WR, Al'Absi M, Blick K, Whitsett TL, Wilson MF [Stress-like adrenocorticotropin responses to caffeine in young healthy men.](#) *Pharmacol Biochem Behav.* (1996 Nov)
117. McCusker RR, Goldberger BA, Cone EJ [Caffeine content of energy drinks, carbonated sodas, and other beverages.](#) *J Anal Toxicol.* (2006 Mar)
118. Desbrow B, Hall S, Irwin C [Caffeine content of Nespresso® pod coffee.](#) *Nutr Health.* (2019 Mar)
119. Ludwig IA, Mena P, Calani L, Cid C, Del Rio D, Lean ME, Crozier A [Variations in caffeine and chlorogenic acid contents of coffees: what are we drinking?.](#) *Food Funct.* (2014 Aug)
120. Fox GP, Wu A, Yiran L, Force L [Variation in caffeine concentration in single coffee beans.](#) *J Agric Food Chem.* (2013 Nov 13)
121. McCusker RR, Goldberger BA, Cone EJ [Caffeine content of specialty coffees.](#) *J Anal Toxicol.* (2003 Oct)
122. Angeloni G, Guerrini L, Masella P, Bellumori M, Daluiso S, Parenti A, Innocenti M [What kind of coffee do you drink? An investigation on effects of eight different extraction methods.](#) *Food Res Int.* (2019 Feb)
123. Stein MD, Friedmann PD [Disturbed sleep and its relationship to alcohol use.](#) *Subst Abus.* (2005 Mar)
124. Park SY, Oh MK, Lee BS, Kim HG, Lee WJ, Lee JH, Lim JT, Kim JY [The Effects of Alcohol on Quality of Sleep.](#) *Korean J Fam Med.* (2015 Nov)
125. Stone BM [Sleep and low doses of alcohol.](#) *Electroencephalogr Clin Neurophysiol.* (1980 Jun)
126. Posadzki PP, Bajpai R, Kyaw BM, Roberts NJ, Brzezinski A, Christopoulos GI, Divakar U, Bajpai S, Soljak M, Dunleavy G, Jarbrink K, Nang EEK, Soh CK, Car J [Melatonin and health: an umbrella review of health outcomes and biological mechanisms of action.](#) *BMC Med.* (2018 Feb 5)
127. Silman RE [Melatonin: a contraceptive for the nineties.](#) *Eur J Obstet Gynecol Reprod Biol.* (1993 Apr)
128. Erland LA, Saxena PK [Melatonin Natural Health Products and Supplements: Presence of Serotonin and Significant Variability of Melatonin Content.](#) *J Clin Sleep Med.* (2017 Feb 15)
129. Matsumoto M, Sack RL, Blood ML, Lewy AJ [The amplitude of endogenous melatonin production is not affected by melatonin treatment in humans.](#) *J Pineal Res.* (1997 Jan)
130. Wright J, Aldhous M, Franey C, English J, Arendt J [The effects of exogenous melatonin on endocrine function in man.](#) *Clin Endocrinol (Oxf).* (1986 Apr)
131. Arendt J, Bojkowski C, Folkard S, Franey C, Marks V, Minors D, Waterhouse J, Wever RA, Wildgruber C, Wright J [Some effects of melatonin and the control of its secretion in humans.](#) *Ciba Found Symp.* (1985)
132. Cavanagh HM, Wilkinson JM [Biological activities of lavender essential oil.](#) *Phytother Res.* (2002 Jun)
133. Shellie R, Mondello L, Marriott P, Dugo G [Characterisation of lavender essential oils by using gas chromatography-mass spectrometry with correlation of linear retention indices and comparison with comprehensive two-dimensional gas chromatography.](#) *J Chromatogr A.* (2002 Sep 13)
134. Basch E, Foppa I, Liebowitz R, Nelson J, Smith M, Sollars D, Ulbricht C [Lavender \(*Lavandula angustifolia* Miller\).](#) *J Herb Pharmacother.* (2004)
135. Hirshkowitz M, Whiton K, Albert SM, Alessi C, Bruni O, DonCarlos L, Hazen N, Herman J, Katz ES, Kheirandish-Gozal L, Neubauer DN, O'Donnell AE, Ohayon M, Peever J, Rawding R, Sachdeva RC, Setters B, Vitiello MV, Ware JC, Adams Hillard PJ [National Sleep Foundation's sleep time duration recommendations: methodology and results summary.](#) *Sleep Health.* (2015 Mar)
136. Choi OH, Shamim MT, Padgett WL, Daly JW [Caffeine and theophylline analogues: correlation of behavioral effects with activity as adenosine receptor antagonists and as phosphodiesterase inhibitors.](#) *Life Sci.* (1988)
137. Ikeda M, Sugiyama T, Wallace CS, Gompf HS, Yoshioka T, Miyawaki A, Allen CN [Circadian dynamics of cytosolic and nuclear Ca²⁺ in single suprachiasmatic nucleus neurons.](#) *Neuron.* (2003 Apr 24)
138. Kong H, Jones PP, Koop A, Zhang L, Duff HJ, Chen SR [Caffeine induces Ca²⁺ release by reducing the threshold for luminal Ca²⁺ activation of the ryanodine receptor.](#) *Biochem J.* (2008 Sep 15)