Creatine Compendium

Version 1.0 | As of July 2026

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Contents

Key Points at a Glance

- **The best form:** Classic creatine monohydrate is the most thoroughly researched, safest, and most effective form.
- **Dosage:** 3 to 5 g daily (taken continuously, without a loading phase) is enough for most adults.
- **The lever:** Creatine has the greatest effect on muscle mass and bone structure when combined with regular strength training.
- **Safety:** According to current research, creatine is considered extremely safe for healthy individuals, even in the long term.
- **Important exception:** If you have existing kidney disease or are taking medication regularly, you must consult a doctor before supplementing.

Evidence, Safety, and Suitability: The Three Ratings Explained

Starting in Chapter 1, every key statement carries up to three ratings: an Evidence Rating (🟢🟡🔴) for how well-supported it is scientifically, Safety symbols (✅⚠️⛔) for how much caution it requires, and a Suitability label without a symbol for who it's meant for. Color is always paired with text, so the classification also works for color blindness and in black-and-white print.

Evidence Rating

- 🟢 **Established** — solid body of research: multiple converging studies or broad scientific consensus (e.g., position stands from professional societies).
- 🟡 **Mixed** — plausible mechanism or early studies, but (still) limited, inconsistent, or based on few studies.
- 🔴 **Speculative** — theoretically plausible or popular, but not sufficiently supported by current research.

Note on Chapter 2: Where a rating appears on a myth, it rates the evidence for the correction — not the myth. "Myth 1: 🟢 Creatine damages the kidneys (False)." therefore means: the refutation is well supported.

Safety

rates how much caution is warranted for certain groups or situations – independent of how well an effect is supported.

- ✅ **No restriction** — for healthy adults with no known risk factors.
- ⚠️ **Individual** — situation-dependent, e.g., depending on pre-existing conditions or life stage.
- ⛔ **Caution** — medical consultation advised before use.

Suitability

doesn't answer "does it work?" or "is it dangerous?", but "who does supplementing make sense for?"

- **General** — makes sense for most healthy, training adults.
- **Individual** — the benefit depends strongly on the goal, training status, or individual baseline values.
- **Not without professional guidance** — sensible only after medical clearance.

1. Basics and Natural Occurrence

- **What is creatine:** 🟢 A natural metabolite (a naturally occurring molecule or metabolic product) discovered in 1832. It supports the cell's energy currency, ATP (adenosine triphosphate), by rapidly regenerating spent ATP.
- **Production in the Body:** 🟢 The body synthesizes about 1 to 3 g of creatine per day. Synthesis occurs primarily in the kidneys, liver, and pancreas. The brain also produces a small amount for its own local needs. Systemic creatine is transported via the blood to the muscles, where 95% of it is stored.
- **Natural Food Sources:** 🟢 Found almost exclusively in animal tissue (red meat, poultry, and seafood such as herring and salmon). Dairy products contain only minimal amounts.
- **Vegetarians and vegans:** 🟢 Since they do not consume creatine through their diet, they have lower baseline stores and therefore statistically show the greatest increases when taking supplements.

2. The Biggest Myths About Creatine

- **Myth 1: Creatine damages the kidneys (False).** 🟢 A classic false alarm in blood tests. When creatine is broken down in the muscles, the breakdown product creatinine is produced. An elevated creatinine level mathematically lowers the estimated GFR (glomerular filtration rate) in laboratory calculations. Long-term studies show that in people with healthy kidneys, creatine does not damage the kidneys.
- **Myth 2: Creatine causes unwanted water retention (Partially true, but positive).** 🟡 At high doses (loading phase) in particular, some water retention may occur initially. However, this water is drawn into the muscle cells (intracellularly). This increases cell volume and can positively influence the body's protein synthesis. It does not cause a "bloated" or puffy look under the skin.
- **Myth 3: Creatine is only for men (False).** 🟢 Women respond exceptionally well to creatine. It supports strength, endurance, and the maintenance of lean body mass when combined with exercise.
- **Body weight and dosage:** 🟢 Because women on average have a lower body weight, a flat dose of 3–5 g/day often represents a relatively higher dose for them than for a heavier man. A weight-based approach (roughly 0.1 g/kg of body weight per day) can therefore make more sense than a fixed gram amount.
- **Myth 4: Creatine causes hair loss (False).** 🟢 The myth goes back to a single study of 20 rugby players (van der Merwe et al., 2009). It was cleanly designed – double-blind, placebo-controlled, crossover – but measured a hormone level, not hair loss: dihydrotestosterone (DHT) rose by 56% after the loading phase. Hair was never examined, and the finding has never been replicated in follow-up studies; there is no proven link to hair loss.
- **Myth 5: Creatine causes muscle cramps (False).** 🟢 There is no evidence that creatine triggers cramps. Some sports science data even suggests that, in extreme heat, improved intracellular hydration may provide slight protection against dehydration.
- **Myth 6: You need to cycle off creatine periodically (False).** 🟢 Long-term use is safe for healthy individuals. The body's own synthesis returns to normal levels without any problems after discontinuation; "cycling" offers no scientific benefit.
- **Myth 7: Milk (or dairy products) blocks creatine absorption (False, if anything the opposite).** 🟢 The carbohydrates and proteins in milk trigger an insulin release that supports the transport of creatine into the muscle cell. A controlled study found that combining creatine with carbohydrates and protein increased creatine retention in the body by around 25% compared to taking creatine alone (Steenge, Simpson & Greenhaff, 2000). This should not be confused with another, genuine phenomenon: milk (or dairy products) can inhibit the absorption of certain antibiotics (e.g., tetracyclines) via calcium binding–but this affects that specific class of drugs, not creatine.

3. Muscle Building and Physical Performance

- **Performance Enhancement:** 🟢 Increases short-term training capacity (more repetitions and maximum strength in the 10–15-second range). It also supports recovery between sets and after intense training sessions.
- **Muscle mass:** 🟢 When combined with strength training, supplementation leads on average to an increase of approximately 1.2 to 2 kg of lean mass (a combination of water and muscle protein) and can inhibit protein breakdown. Part of this early gain is due to increased intracellular water retention.
- **Anti-inflammatory:** 🟡 Exhibits anti-catabolic (muscle-protecting) properties and can reduce markers of systemic inflammation and muscle damage during extreme endurance exercise.
- **Everyday function in older adults**: 🟡 Improves functional strength, making everyday tasks (such as standing up from a chair) noticeably easier.

4. Bone Health

- **Effect on bone density**: 🟡 Creatine may slow age-related loss of bone density in some scenarios by providing additional energy to bone-building cells (osteoblasts).
- **Important limitation:** 🟡 The evidence is mixed. A positive effect on bone structure is observed exclusively in combination with regular strength training (resistance training) and is not replicated with the same consistency across all clinical studies.
- **Menopause:** 🟡 The decline in estrogen during menopause likely reduces the body's own creatine synthesis and utilization. Early studies — including work from Candow's research group — are specifically examining whether postmenopausal women benefit particularly from supplementation for muscle and bone health; the evidence is still emerging, but promising.
- **Menstrual cycle:** 🔴 Whether creatine kinetics or effects change systematically across the menstrual cycle has barely been studied directly so far — the current evidence isn't sufficient for cycle-phase-specific recommendations.

5. Brain Function and Mental Health

- **The Stressed Brain:** 🟡 The brain consumes about 20% of daily energy. While a healthy, well-rested brain gains little from additional creatine, supplementation becomes scientifically interesting during periods of metabolic stress (acute sleep deprivation, jet lag, extreme study periods).
- **Cognitive performance:** 🟡 In cases of severe sleep deprivation, high-dose creatine supplementation can temporarily stabilize reaction time and mental endurance during complex tasks.
- **Mental Health and Depression:** 🟡 A widely cited clinical study showed that creatine, when taken as a supplement alongside certain antidepressants (SSRIs), could improve the remission rate in women. However, since follow-up studies have yielded mixed results, this is considered a promising approach but not yet a widely established fact.
- **Neuroprotection and Trauma:** 🟡 In cases of concussions (traumatic brain injuries), clinical research (primarily from pediatrics) suggests that administration following the injury could support cellular recovery and alleviate symptoms.

6. Dosage (Practice and Protocols)

- **Muscle health:** 🟢 3 to 5 g daily (about one measuring spoon) is entirely sufficient. For older adults (over 50), approximately 5 g is often recommended due to the natural loss of muscle mass in the lower extremities.
- **Bones and brain in studies:** 🟢 Higher dosages (e.g., 3 to 11 g daily for bone studies, depending on the study protocol, or 10 g as a “safety net” for the brain) stem primarily from specific scientific study designs (e.g., weight-based approaches at 0.14 g/kg). These are not rigid everyday recommendations, but they do show that higher tissue saturations are often investigated for effects outside the muscle.
- **Loading phase vs. continuous intake:** 🟢 A “loading phase” (20 g divided into 4 doses over 5–7 days) saturates the muscles more quickly but more frequently leads to gastrointestinal discomfort. A constant dose of 3–5 g daily leads to the exact same level of saturation after about 30 days.
- **Stomach discomfort:** 🟢 Usually occurs with high single doses due to the osmotic effect of undissolved creatine powder in the intestines. This can be remedied by dissolving it in sufficient lukewarm water or by dividing it into smaller doses throughout the day.
- **Blood-Brain Barrier and Saturation Dynamics:** 🟢 The brain absorbs creatine much more slowly than skeletal muscle, as it is protected by the blood-brain barrier and must import creatine selectively via a specific transporter (CRT1). A single extreme dose does not “break through” this barrier. Therefore, cognitive effects–unlike the rapid muscular effects–require a longer, consistent saturation phase of several weeks to measurably raise creatine levels in the CNS.

Dosage Guide: Recommendations by Goal

Goal	Recommended Dose	Timing	Important Note
General Fitness	3–5 g/day	Any time	Focus on daily consistency
Maximal Strength and Muscle Building	3–5 g/day	Post-workout	Combined with carbs/protein
Bone and Brain Health	5–10 g/day	Split into several doses	Requires slow saturation; evidence weaker than for muscle building
Maintenance in older adults (50+)	Approx. 5 g/day	Daily	Focus on maintaining muscle mass

7. Choosing the Right Product and Optimizing Intake

- **The Best Form:** 🟢 Classic, pure creatine monohydrate is the most thoroughly researched, safest, and most affordable form. More expensive derivatives (such as creatine HCl or buffered creatine) offer no proven therapeutic benefits.
- **Quality characteristics:** 🟢 Look for the “Creapure” label (a high-purity production standard, manufactured in Germany) and third-party certifications (e.g., NSF or the Cologne List) to rule out contaminants (e.g., heavy metals).
- **The absorption mechanism (sodium and carbohydrates):** 🟢 The creatine transporter into the muscle cell is sodium-dependent. Studies have shown that extremely high amounts of carbohydrates (~90 g of simple carbs) can significantly accelerate creatine absorption through a massive insulin release.
- **Practical recommendation:** 🟢 Since such amounts of sugar are impractical in everyday life, it is entirely sufficient to simply take creatine with a normal meal, a post-workout shake (protein and carbohydrates), or a pinch of salt. The timing (morning vs. evening) is secondary–consistency in daily intake is what matters.
- **Fact Check: Creatine and Caffeine:** 🟢 It’s often claimed that caffeine negates the effects of creatine. The myth goes back to a single study with nine participants (Vandenberghe et al., 1996), in which caffeine was taken alongside the loading phase for six days – not as a single cup before training. Current sports science data show no negative interaction. You can safely combine creatine with your coffee or tea. What matters is daily intake, not the accompanying beverage.

8. Safety, Risk Groups, and Restrictions

- **General Safety:** 🟢 Creatine is one of the most thoroughly studied dietary supplements worldwide and is extremely safe for healthy individuals across all age groups. ✅ No restriction.
- **Important Restrictions and Contraindications:**
  - **Consult a Doctor**: 🟢 Individuals with pre-existing kidney disease or those who must take medications that are potentially harmful to the kidneys (nephrotoxic) should consult a doctor before starting supplementation. ⛔ Caution.
  - **Drug Interactions**: 🟡 No direct pharmacological interaction between creatine and common medications has been documented. However, there is a diagnostic effect worth noting: creatine raises blood creatinine levels–the standard marker used to estimate kidney function (eGFR). If your doctor isn't told about your creatine use, this can be mistakenly interpreted as impaired kidney function. When combined with potentially nephrotoxic substances (e.g., high-dose or long-term NSAIDs such as ibuprofen, aminoglycoside antibiotics, or immunosuppressants such as cyclosporine or tacrolimus), there is no evidence that creatine adds to kidney strain–but also no study that specifically rules this out. This caution is therefore a precaution, not a proven risk (Kreider et al., 2017).
  - **Pregnancy and Breastfeeding**: 🟡 The scientific data on this topic is extremely limited. Due to a lack of sufficient clinical studies, use during this phase is generally not recommended. ⛔ Caution.
- **Children and adolescents**: 🟡 Pediatric research shows a good safety profile in young athletes and for certain medical conditions. However, there is no blanket "1-gram rule." Dosages here–if any–should always be based on clinical guidelines or body weight (approx. 0.03–0.05 g/kg). ⚠️ Individual.
- **The "non-responder" phenomenon**: 🟢 About 20–30% of people show little or no response to creatine supplementation–for genetic or dietary reasons–as their muscle stores are already close to saturation.
- **Hydration:** 🟢 Creatine does not require excessive additional water intake in daily life beyond the normal, healthy sensation of thirst.
- **When might creatine be less beneficial?**
  - 🟢 Individuals with already very high creatine stores (e.g., due to very high meat consumption).
  - 🟢 People who participate in sports without significant short-term exertion (e.g., pure endurance training at moderate intensity).
  - 🟢 People who do not engage in regular strength training (many of the positive effects, especially on muscles and bones, are then significantly reduced).

Suitability: Who Does Creatine Make Sense For?

- **General:** Healthy, training adults aiming for muscle building, strength, or general fitness – here the evidence is strongest and the benefit most reliable.
- **Individual:** Those primarily targeting bone health, cognitive performance under stress, or supportive use for depression – the evidence is promising but not yet as well established as for muscle building; realistic expectations are warranted here. The same applies to people with already high meat consumption or without strength training, where the effect is smaller (see "non-responders" and the list above).
- **Not without professional guidance:** Pre-existing kidney disease, use of nephrotoxic medications, pregnancy, and breastfeeding – get medical clearance before use (see above).

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9. Strength Training: The Primary Lever

- **The wrench and the hammer**: 🟢 Creatine is an excellent "wrench" for health–but strength training is the heavy "hammer." Without the mechanical stimulus of training, most of the effects on muscles and bones simply don't materialize.
- **Muscle Loss with Age**: 🟢 Starting at age 40, people lose noticeable muscle mass without countermeasures (rough estimates range from 3–8% per decade). Progressive strength training at least two days a week is the most effective way to counteract this loss (sarcopenia).

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10. Potential Supplement Combinations (Hypotheses and Synergies)

- **Combination with taurine / beta-alanine:** 🟡 These combinations are mechanistically very plausible (creatine provides the energy for the first few seconds, beta-alanine buffers muscle acidification afterward; taurine, like creatine, supports cell volume). However, direct, large-scale combination studies demonstrating a clear, synergistic "1+1=3" effect in humans are still scarce. This is a biochemically sound but largely theoretical synergy.
- **Combination with choline donors (e.g., alpha-GPC) for the brain:** 🔴 The idea of combining energy supply (creatine) with the supply of neurotransmitters (choline for acetylcholine) during mental stress is an exciting neurobiological approach. Here, too, the same applies: In practice, this is a plausible hypothetical model that still awaits broad clinical validation.

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- **Note:** I am not a doctor, nutritionist, or certified sports scientist. This document is the result of personal research and is intended solely for personal information.
- **Source of Information:** The core content and structure of this guide are based on the scientific findings and study results of Dr. Darren Candow (Professor of Kinesiology specializing in creatine supplementation).
- **Methodology and Quality Assurance:** For quality assurance purposes, the content was additionally reviewed using modern AI assistance systems (Gemini and Claude) to ensure consistency with the current state of scientific knowledge and the primary sources listed in the bibliography. Figures from AI suggestions were, as a rule, not adopted without independent primary-source verification. The final selection, evaluation, and compilation of the content was carried out by the author.
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11. Bibliography and Scientific References

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