



n-acetylcysteine

N-acetylcysteine (NAC) is a modified form of the amino acid L-cysteine. It is used medically to treat acetaminophen overdose and loosen thick respiratory mucus, and sold as a supplement largely because it supplies cysteine for glutathione production. ^[1] ^[2]

How it works

NAC has two important actions:

- Supports glutathione synthesis: it provides cysteine, which can be a limiting ingredient in producing glutathione—one of the body’s main intracellular antioxidant systems. This is more precise than simply calling NAC a “free-radical scavenger.” ^[2]
- Breaks up mucus: its thiol group helps reduce disulfide bonds linking mucus proteins, making secretions less viscous. ^[3]

What the evidence supports

Use	Evidence and limitations
Acetaminophen poisoning	An established, potentially lifesaving antidote. Treatment is most effective when started early; suspected overdose requires urgent medical care, not self-treatment with supplement doses. ^[1]
Thick respiratory mucus	An established mucolytic use, although the appropriate formulation and route depend on the condition. ^[1]
General antioxidant supplementation	The biochemical rationale is well established, but increasing antioxidant capacity does not automatically demonstrate better health outcomes in otherwise healthy people. Clinical benefits depend on the condition studied. ^[2] ^[3]
Longevity or “anti-aging”	Mechanistic and experimental findings are interesting, but they do not establish that NAC supplementation extends human lifespan. ^[2]

Oral doses and precautions

Oral studies commonly use 600–1,800 mg daily, often divided into two or three doses. That is a description of studied dosing—not a universal recommendation or an overdose-treatment regimen. ^[3]

The most common oral side effects are nausea, stomach upset, vomiting, and diarrhea. NAC can intensify nitroglycerin’s blood-pressure-lowering effects and cause severe headaches; inhaled NAC can provoke bronchospasm, particularly in susceptible people. ^[4] ^[1]

Are you interested in NAC for a particular health goal, its pharmacology, or formulation and stability?

What mental health conditions is it studied for

NAC has been studied for several mental-health conditions, mostly as an **adjunct**—an addition to standard treatment rather than a replacement. The main research areas are compulsive behaviours, schizophrenia, substance-use disorders, and mood disorders, with mixed results depending on the condition. ^[12]

Conditions studied

Condition	What the research suggests
Trichotillomania—compulsive hair pulling	Some encouraging controlled-trial results, particularly in adults, but findings are not consistent across age groups and studies. ^[12]
Excoriation disorder—compulsive skin picking	Promising trial evidence for reducing picking urges and behaviour, though the evidence base remains relatively small. ^[12]
Obsessive-compulsive disorder (OCD)	Studied mainly alongside SSRIs. Results are mixed: a 2024 meta-analysis of six trials involving 195 patients found a benefit at 5–8 weeks, but not a consistent benefit across other treatment durations or separate obsession and compulsion scores. ^[13]
Schizophrenia	Studied alongside antipsychotics, with evidence of improvements in overall symptoms and possibly “negative symptoms”—such as reduced motivation, emotional expression, and social engagement. Trials are relatively small, so this is not a substitute for antipsychotic treatment. ^[12]
Substance-use disorders	Studied for cannabis, cocaine, nicotine, and methamphetamine use, particularly craving and relapse prevention. Results are inconsistent; some cocaine findings suggest a possible role in maintaining abstinence rather than initiating it. ^[12]
Bipolar disorder	Studied mainly for bipolar depression and functioning, rather than as a treatment for acute mania. Early promising findings have not translated into consistent benefits across trials and reviews. ^[14] ^[12]
Major depressive disorder	Studied as an add-on treatment. Findings are mixed, without a clear, consistently demonstrated antidepressant effect. ^[14] ^[12]
Other repetitive or compulsive behaviours	Smaller studies have examined nail biting and pathological gambling; evidence is preliminary. ^[12] ^[15]

NAC has also been investigated in autism spectrum disorder, a neurodevelopmental condition, particularly for associated irritability and repetitive behaviours—not as a cure for autism. ^[16]

Why it might affect mental health

The rationale goes beyond its antioxidant effects. NAC supplies cysteine for glutathione production and influences glutamate regulation through the cystine–glutamate exchange system. These mechanisms could affect brain circuits involved in compulsive behaviour, craving, and psychiatric symptoms—but a plausible mechanism does not establish clinical effectiveness. ^[17] ^[12]

The practical distinction is that “studied for” does not mean “proven to treat.” Compulsive hair pulling and skin picking have encouraging signals, while OCD, depression, bipolar disorder,

and addiction have more inconsistent findings.^[13] ^[12]



does NAC worsen muscle wasting in a mouse trial

Yes—a 2017 mouse study found that NAC reduced muscle weight and markedly impaired body-weight gain. But “NAC worsens muscle wasting” needs qualification: these were young, growing mice, including a muscular-dystrophy model, receiving NAC at 2% in drinking water—not a human supplementation trial.^[22]

What the study found

The paper, “Pre-clinical evaluation of N-acetylcysteine reveals side effects in the mdx mouse model of Duchenne muscular dystrophy,” treated six-week-old mice for six weeks. It included both dystrophin-deficient *mdx* mice and healthy control mice.^[23] ^[22]

Finding	Result
Body weight	NAC-treated mice in both groups lost approximately 9% of their starting body weight during the first week.
Subsequent growth	Total weight gain over six weeks was approximately 2.5 g with NAC versus 10 g without it.
Muscle weight	The extensor digitorum longus—a lower-leg muscle—was approximately 22% lighter in NAC-treated <i>mdx</i> mice. This reduction was not significant in healthy controls.
Other effects	NAC reduced inflammation and oxidative stress and improved measures of muscle force normalized to muscle size.

All of these results came from the same experiment. The authors cautioned that improved force relative to muscle size can be misleading when the treatment itself reduces muscle size.^[22] ^[23]

Does that demonstrate muscle wasting?

It demonstrates an adverse growth and muscle-weight signal, but not necessarily accelerated muscle breakdown. The mice were still growing, and dystrophic muscle can become abnormally enlarged through pathological changes. A later mouse study also found reduced dystrophic muscle mass with NAC, but linked it partly to reduced abnormal muscle-fibre branching and splitting—not simply loss of healthy muscle tissue.^[24]

The 2017 authors suggested that excessive cysteine exposure might contribute to impaired growth, but that was a proposed explanation, not an established mechanism.^[23]

What it means for taking NAC

This is a legitimate preclinical caution, not proof that ordinary oral NAC supplementation causes human muscle wasting. The result is also context-dependent: other mouse experiments found that NAC reduced muscle atrophy in sepsis and chronic liver disease. Taken together, the animal evidence does not support a blanket claim that NAC either causes or prevents muscle wasting.^[25] ^[26] ^[22]

What about human trials on NAC and muscle mass

Human trials have **not established** that NAC causes muscle wasting—but they also have not adequately tested whether long-term daily NAC affects muscle mass or resistance-training gains. Most human exercise studies measure fatigue, strength, soreness, or biochemical markers rather than actual changes in muscle size. ^[40] ^[41]

The main human finding behind the concern

A 2013 randomized, double-blind crossover trial studied 10 men after a deliberately muscle-damaging workout: 300 eccentric contractions, meaning contractions while the muscle lengthens under load. Participants received NAC at 20 mg/kg/day or placebo during eight days of recovery—equivalent to 1,600 mg/day for an 80-kg person. ^[42]

The results were mixed:

- Early recovery: NAC reduced inflammatory and muscle-damage markers and lessened the initial strength decline over the first two days.
- Later recovery: by the end of follow-up, performance had fully recovered only in the placebo condition.
- Muscle biopsies: NAC blunted activation of Akt–mTOR–p70S6K signalling, which participates in muscle growth and repair, and abolished the increase in MyoD, a regulator of muscle regeneration. ^[42]

Crucially, this was not a long-term hypertrophy study. It showed altered repair signalling and recovery after an unusually damaging workout—not measured loss of muscle mass or proof of reduced gains over months of training. ^[42]

How much direct muscle-mass evidence is there?

Question	What the human evidence tells us
Does NAC alone cause muscle loss?	The available clinical literature does not establish this. Direct, well-designed muscle-mass trials remain limited. ^[40]
Does it reduce resistance-training hypertrophy?	This remains unresolved; short-term signalling and recovery findings cannot determine long-term muscle growth. ^[40] ^[42]
Does it improve muscle performance?	Findings vary. A 2023 systematic review included 16 controlled studies involving 232 men, but interventions lasted only 1–21 days and primarily examined performance and biomarkers—not sustained muscle-mass changes. ^[41]
Do GlyNAC studies settle the question?	No. GlyNAC combines glycine with NAC, and reported improvements in strength or physical function cannot establish the effect of NAC alone on muscle mass. ^[43]

What this means for your concern

The human concern is better described as “NAC may interfere with some exercise-repair responses under certain conditions,” rather than “NAC causes muscle wasting.” There is a genuine experimental signal worth taking seriously, but the evidence does not quantify a loss of muscle or training gains from routine supplementation. Equally, the short duration and indirect outcomes of most trials mean they cannot guarantee that long-term use has no effect. [\[41\]](#) [\[40\]](#) [\[42\]](#)



What dosages were used in human NAC trials

In the human muscle/exercise trials we’ve been discussing, oral NAC doses included 600–1,200 mg per dose or day, and weight-based regimens such as **20 mg/kg/day**. The study that raised concern about impaired muscle repair used that latter dose—not an exceptionally large overdose. [\[67\]](#) [\[68\]](#)

Doses used in relevant trials

Trial or protocol	NAC dose	Timing / duration
Michailidis et al., 2013—the muscle-repair signalling study	20 mg/kg/day orally	During approximately eight days of recovery after 300 eccentric contractions. [69] [67]
Sakelliou et al.—recovery after muscle-damaging exercise	20 mg/kg/day orally	Eight days. [67]
Christensen et al.—exercise-performance testing	20 mg/kg orally	Acute administration before exercise. [68]
Ferreira et al.—exercise/fatigue protocols	600 mg or 1,200 mg orally	Acute dosing; approximately 9 or 18 mg/kg in the participants. [70]
Several other exercise studies	1,200 mg/day orally, divided as 600 mg twice daily	Duration varied by study. [68]

What 20 mg/kg/day means

Body weight	Total daily dose
60 kg / 132 lb	1,200 mg
70 kg / 154 lb	1,400 mg
80 kg / 176 lb	1,600 mg
90 kg / 198 lb	1,800 mg
100 kg / 220 lb	2,000 mg

These are conversions of the studied regimen, not recommended doses.

Some trials used intravenous NAC

Several exercise experiments used an IV infusion of 125 mg/kg/hour for 15 minutes, followed by 25 mg/kg/hour before and/or during exercise. Those are infusion rates—not single-dose amounts—and cannot be directly equated with oral supplement dosing. ^[70] ^[71]

The important interpretation

The muscle-repair concern arose at an oral dose overlapping with common supplement use: roughly 1,200–2,000 mg/day depending on body weight. However, that small trial measured recovery and signalling after a damaging workout, not long-term muscle loss. It therefore does not establish that 600 mg, 1,200 mg, or any other daily dose causes—or avoids—impaired hypertrophy. ^[69] ^[72]



1. <https://www.ncbi.nlm.nih.gov/books/NBK537183/>
2. <https://pmc.ncbi.nlm.nih.gov/articles/PMC8234027/>
3. <https://examine.com/supplements/n-acetylcysteine/>
4. <https://www.mskcc.org/cancer-care/integrative-medicine/herbs/n-acetylcysteine>
5. <https://en.wikipedia.org/wiki/Acetylcysteine>
6. <https://www.healthline.com/nutrition/nac-benefits>
7. <https://www.medpagetoday.com/meetingcoverage/asfnr/123392>
8. <https://www.aafp.org/afp/2009/0801/p265>
9. <https://www.sigmaaldrich.com/CA/en/product/mm/106425>
10. <https://primarycare.ementalhealth.ca/Peterborough-County/N-acetylcysteine-NAC/index.php?m=article&ID=71281>
11. <https://pubchem.ncbi.nlm.nih.gov/compound/Acetylcysteine>
12. <https://pmc.ncbi.nlm.nih.gov/articles/PMC6217900/>
13. <https://pmc.ncbi.nlm.nih.gov/articles/PMC11456833/>
14. <https://onlinelibrary.wiley.com/doi/abs/10.1111/acps.12862>
15. <https://psychiatry-psychopharmacology.com/index.php/pub/article/download/1140/1132/1280>
16. <https://www.sciencedirect.com/science/article/pii/S0149763415001190>
17. <https://cdnsiencepub.com/doi/10.1503/jpn.100057>
18. <http://www.moodclinic.ca/wp-content/uploads/2019/09/NAC-Therapy.pdf>
19. <https://pubmed.ncbi.nlm.nih.gov/29457216/>
20. <https://www.cpn.or.kr/journal/view.html?doi=10.9758/cpn.2015.13.1.12>
21. <https://www.psychiatryredefined.org/n-acetylcysteine-and-mental-health/>
22. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5709333/>
23. <https://pmc.ncbi.nlm.nih.gov/articles/PMC5709333/>
24. <https://www.frontiersin.org/journals/physiology/articles/10.3389/fphys.2023.1109587/full>
25. <https://pmc.ncbi.nlm.nih.gov/articles/PMC11048408/>

26. <https://investigadores.uandes.cl/en/publications/n-acetyl-cysteine-attenuates-the-sarcopenia-and-muscle-apoptosis-/-/>
27. <https://www.mdpi.com/1422-0067/21/12/4293>
28. <https://saludyejercicio.co/wp-content/uploads/2017/10/EffectsofN-acetylcysteineonisolated.pdf>
29. <https://ctv.veeva.com/study/effects-of-protein-and-nac-co-ingestion-on-skeletal-muscle-recovery>
30. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2375717/>
31. <https://www.sciencedirect.com/science/article/pii/S0960896611014052>
32. <https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0283806&type=printable>
33. <https://www.helsinki.fi/en/news/cancer/vitamin-b3-attenuates-cancer-related-muscle-loss-mice>
34. <https://pmc.ncbi.nlm.nih.gov/articles/PMC7760926/>
35. <https://www.nad.com/news/restoring-nad-via-niacin-curtails-muscle-loss-from-cancer-italian-finnish-scientists>
36. <https://www.sciencedirect.com/science/article/pii/S0741521413020065>
37. <https://pmc.ncbi.nlm.nih.gov/articles/PMC2375717/>
38. <https://www.nutraingredients.com/Article/2013/06/06/Could-NAC-supplements-be-a-hindrance-for-sports-nutrition/>
39. <https://www.mdpi.com/2076-3921/14/11/1344>
40. <https://www.sciencedirect.com/science/article/pii/S0531556526001579>
41. <https://pmc.ncbi.nlm.nih.gov/articles/PMC10255663/>
42. <https://pubmed.ncbi.nlm.nih.gov/23719546/>
43. <https://pubmed.ncbi.nlm.nih.gov/33007928/>
44. <https://pmc.ncbi.nlm.nih.gov/articles/PMC11741611/>
45. <https://clinicaltrials.gov/study/NCT05604586>
46. <https://examine.com/faq/does-n-acetylcysteine-affect-exercise-performance/>
47. <https://www.mdpi.com/2076-3921/12/1/53>
48. <https://www.nad.com/news/glynac-and-exercise-for-age-related-muscle-loss-mechanisms-and-clinical-evidence>
49. <https://www.nmi.health/n-acetylcysteine-a-review-of-clinical-use-and-efficacy/>
50. <https://pubmed.ncbi.nlm.nih.gov/?db=PubMed>
51. <https://onlinelibrary.wiley.com/doi/epdf/10.1111/jcmm.70198>
52. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5015649/>
53. [https://ajcn.nutrition.org/article/S0002-9165\(23\)05152-3/pdf](https://ajcn.nutrition.org/article/S0002-9165(23)05152-3/pdf)
54. <https://pubmed.ncbi.nlm.nih.gov/10956377/>
55. <https://herzenberglab.stanford.edu/sites/g/files/sbiybj27506/files/media/file/lah448.pdf>
56. <https://europepmc.org/article/MED/11029607>
57. <https://www.ironmagazine.com/2013/n-acetylcysteine-supplement-inhibits-post-workout-muscle-recovery/>
58. https://evipedia.ai/n_acetylcysteine_er
59. <https://scispace.com/pdf/nutrients-and-hiv-part-three-n-acetylcysteine-alpha-lipoic-2t2h8i9h4d.pdf>
60. <https://www.frontiersin.org/journals/physiology/articles/10.3389/fphys.2023.1109587/full>
61. <https://www.nutraingredients.com/Article/2013/06/06/Could-NAC-supplements-be-a-hindrance-for-sports-nutrition/>

62. <https://publications.ersnet.org/content/erjor/9/4/00102-2023>
63. <https://journals.physiology.org/doi/full/10.1152/japplphysiol.00990.2016>
64. <https://jtd.amegroups.org/article/view/21386/html>
65. <https://www.rivm.nl/bibliotheek/rapporten/2024-0086.pdf>
66. <https://www.sciencedirect.com/science/article/pii/S0002916523051523>
67. <https://onlinelibrary.wiley.com/doi/full/10.1111/jcmm.70198>
68. <https://onlinelibrary.wiley.com/doi/10.1111/jcmm.70198?msocid=37c0749eb870614e3ca8636cb9e560bd>
69. <https://pubmed.ncbi.nlm.nih.gov/23719546/>
70. <https://onlinelibrary.wiley.com/doi/abs/10.1111/jcmm.70198>
71. https://www.academia.edu/143647684/Influence_of_N_Acetylcysteine_Supplementation_on_Physical_Performance_and_Laboratory_Biomarkers_in_Adult_Males_A_Systematic_Review_of_Controlled_Trials
72. <https://pubmed.ncbi.nlm.nih.gov/37299425/>
73. <https://www.drugs.com/dosage/acetylcysteine.html>
74. <https://theworkoutmag.com/supplements/n-acetylcysteine-dosage-guide-athletes>
75. <https://doi-org.offsitelib.eva.mpg.de/10.1002/ajhb.23342>
76. https://www.nmi.health/wp-content/uploads/2023/01/NMJ_NAC_A-Review-of-Clinical-Use-and-Efficacy.pdf
77. <https://www.sciencedirect.com/science/article/pii/S0531556526001579>
78. <https://www.nutraingredients.com/Article/2013/06/06/Could-NAC-supplements-be-a-hindrance-for-sports-nutrition/>
79. <https://www.sciencedirect.com/science/article/pii/S2405457723000232>
80. <https://pubmed.ncbi.nlm.nih.gov/34208683/>
81. <https://www.hhs.texas.gov/sites/default/files/documents/acetylcysteine-nac-monograph.pdf>