New Scientist

Health

Which dietary supplements actually work and which should you take

From vitamin D to turmeric extracts and probiotics, nutritional supplements are a booming industry. But what is the evidence behind the claimed benefits?

By Alison George

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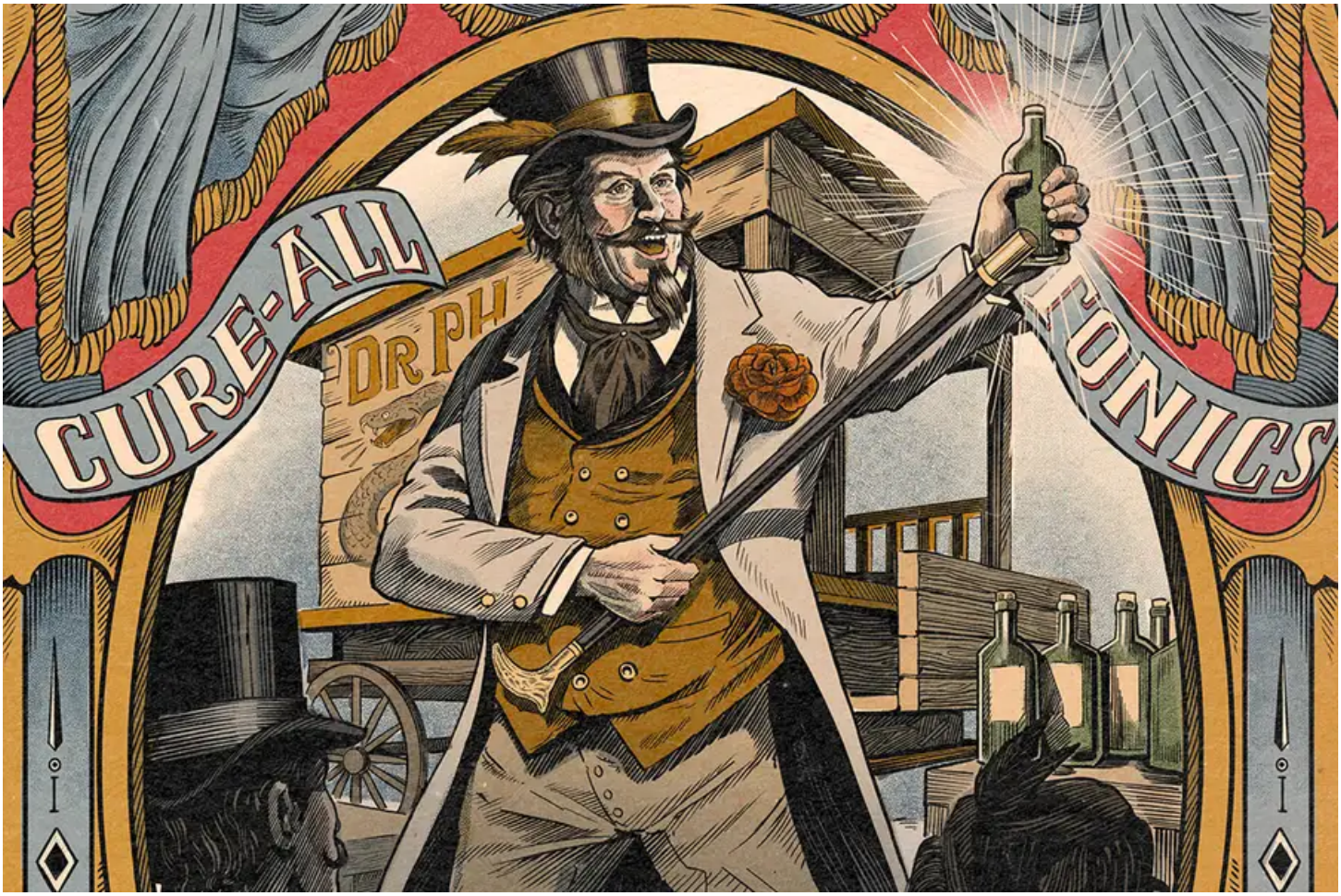


Philip Harris

AT MY local supermarket, I find myself seduced by the range of possibilities in the supplements aisle. Sure, I might be somewhat poorer if I succumb, but who wouldn't be tempted by a brain-boosting formulation including a range of nutrients that "help the maintenance of memory", or the promise of "super immunity"?

There is everything here that my body could need and more, from vitamin C and multivitamins /article/mg22329840-600-a-to-zinc-what-supplements-are-worth-taking/ to formulations with echinacea or turmeric. Online, things get more outlandish, with supplements promising everything from enhanced libido and sports performance to "thermogenic fat burning".

The sheer range of products on offer, and the claims that they are making, is overwhelming and confusing. On the one hand, we are blasted with messages about the nutritional inadequacies of the modern diet: surely adding concentrated doses of the good stuff extracted from food is helpful? Yet at the same time, large studies often suggest that many supplements have no discernible benefits.

"I'm concerned about this dizzying array of dietary supplements on the market, and that many people may be fooled into spending money on supplements that are not helpful to them and that could even be harmful," says JoAnn Manson https://www.hsph.harvard.edu/joann-manson/ at Harvard University.

So here is a guide to help you navigate the complex and often paradoxical world of nutritional supplements. We examine the evidence behind the promises on the labels so you can make better decisions about which products really deserve your hard-earned cash.

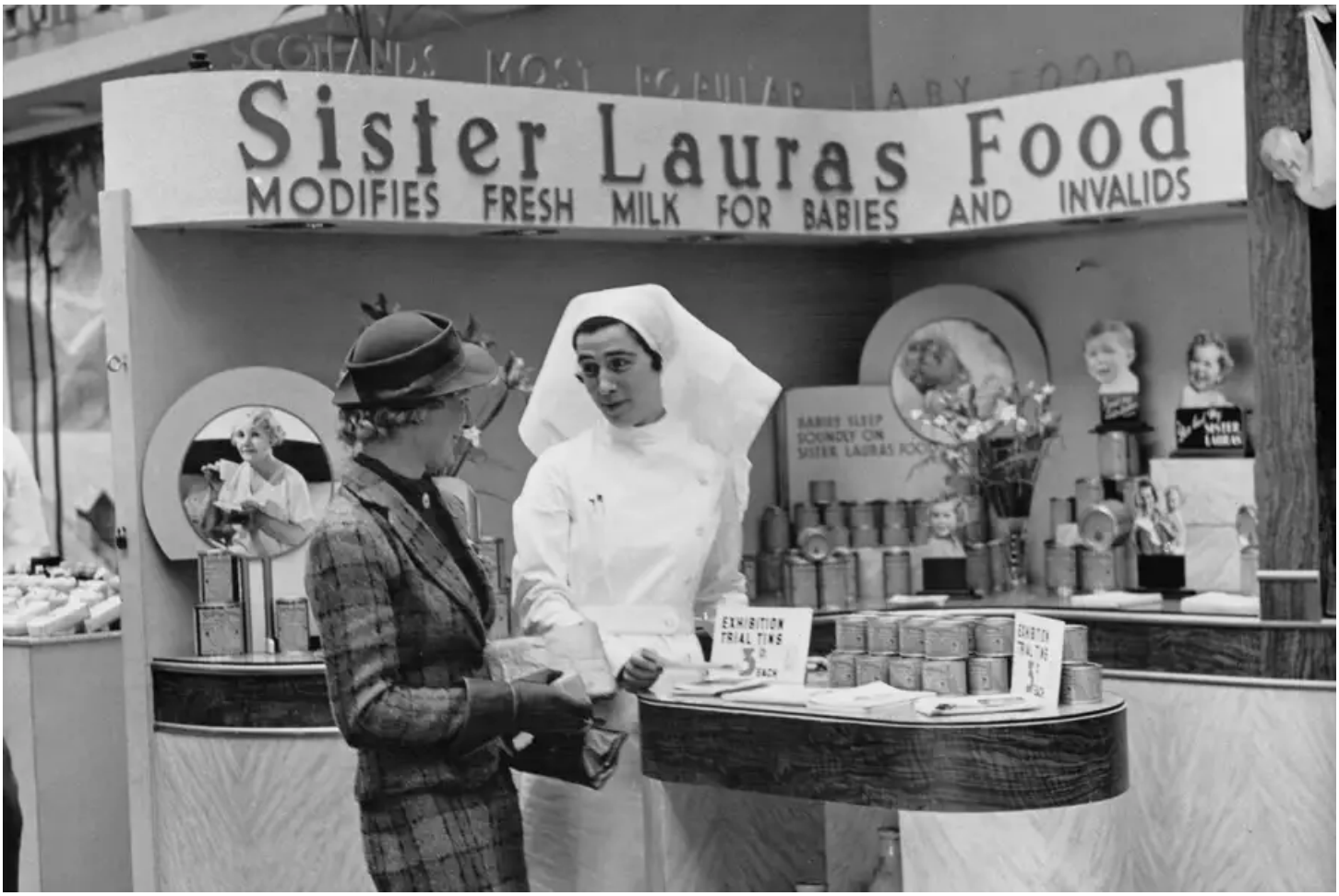
Scientific agencies such as the European Food Safety Authority https://www.efsa.europa.eu/en/topics/topic/food-supplements (EFSA) define supplements as concentrated sources of nutrients or other substances with a "nutritional or physiological effect". These may provide vitamins, minerals, essential fatty acids, fibre, plant or herbal extracts and include live organisms such as probiotics. They come in a variety of forms: tablets, capsules, liquid doses or, increasingly commonly, gummies.

We are guzzling supplements like never before. In 2022, the market reached $164 billion https://www.grandviewresearch.com/industry-analysis/dietary-supplements-market, driven by factors such as an ageing population and the greater focus on personal well-being. "The biggest trend underlying all this is self-care," says Carrie Ruxton https://www.hsis.org/about-hsis/meet-the-experts/ at the Health and Food Supplements Information Service, a UK-based industry body. The number of available products is also booming. In 1994, just 4000 different supplements were available in the US. Today, there are about 90,000, with around 1000 new products coming on the market each year.

Our hunger for supplements dates to the early 20th century, after the first vitamin to be identified, now called vitamin B1, was isolated in 1910. We now know that there are 13 essential vitamins, and around 20 essential minerals, such as zinc, calcium and iron, that must be obtained from food, as the body can't produce them in sufficient quantities.

Along with these discoveries came the notion that nutritional supplements were beneficial for everyone, and it wasn't long before such products hit the market. One of the earliest was Mastin's Yeast Vitamon Tablets, created in the US in 1916. Containing iron, calcium and vitamins A, B and C, advertising posters claimed it would "strengthen nerve force, enrich the blood, clear the skin and act as a general health-building tonic".

So began a long tradition of creating novel dietary supplement formulations based on a new understanding of nutrition and then marketing these products with sometimes extravagant statements about their benefits. In 1991, Japan became the first country to regulate food supplements 🔗 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8326690/, introducing a system to approve statements about the effects of food on the human body. Other countries soon followed suit with their own systems for ensuring the quality and safety of dietary supplements and – crucially – vetting the health claims found in the products' marketing.



The supplements industry emerged in the early 20th century
Fox Photos/Getty Images

The most straightforward are so-called structure/function claims, such as: "Vitamin D contributes to the maintenance of normal bones." According to EFSA – whose guidelines the UK currently applies – and the US Food and Drug Administration (FDA), these claims can be added to any product that contains a large enough dose of the specified substance.

Then there are authorised health claims that contain more specific details, such as: "Calcium and vitamin D help to reduce the loss of bone mineral in post-menopausal women. Low bone mineral density is a risk factor for osteoporotic bone fractures." To permit this kind of statement, most regulatory bodies would require convincing evidence from clinical trials linking a particular substance in the supplement to a reduced risk of disease. The trials needed to prove such a relationship are costly and complicated to conduct, and there is a long list of substances that failed to make the grade.

EFSA also requires extensive checks to ascertain the safety of any new supplement's ingredients. The FDA, by contrast, carries out no such checks. "In the US, we're at the mercy of manufacturers when it comes to the safety of their products," says Pieter Cohen 🔗 https://theforum.sph.harvard.edu/expert-participants/pieter-cohen/ at Harvard

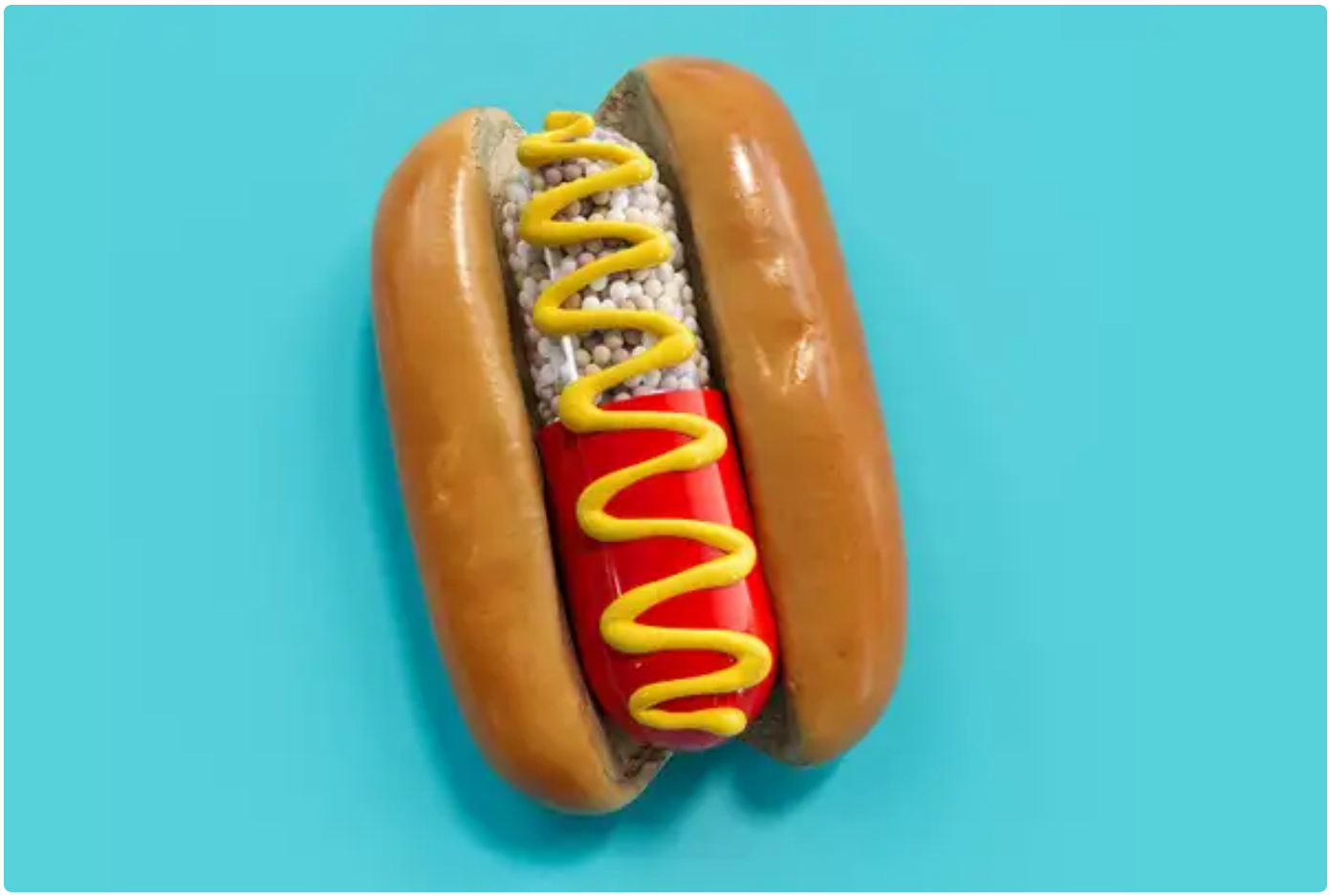
Medical School. "There's zero requirement that the product or the ingredient needs to be tested prior to being sold to consumers." Cohen's research has uncovered prescription medications 🔗 https://jamanetwork.com/journals/jamanetworkopen/article-abstract/2706496 such as sildenafil in supplements marketed for sexual enhancement and unapproved drugs in supplements marketed for cognitive enhancement sold in the US. And a whopping 12 per cent of sports supplements 🔗 http://dx.doi.org/10.1001/jamanetworkopen.2023.23879 contain FDA-prohibited substances, he has found.

Manson is similarly concerned, describing the situation as a "Wild, Wild West". If you live in a country like the US without pre-market testing, she advises only selecting products from reputable retailers that have at least been accredited by a high-quality third-party certification programme.

TikTok tales

The situation can get far wilder online, where you can find many supplements with extravagant claims, especially with regard to weight loss, muscle building and sexual performance. What's more, unless they are from a reputable retailer, you will have no idea what is really in them: they could be sugar pills or contain pharmaceutical ingredients. Although these products should still conform to national regulations of the country in which they are manufactured and the countries in which they are being sold, the enforcement is much trickier for products available online, meaning dubious products can easily fall into consumers' hands." You should be very cautious. You should buy products from reputable brands. If you're seeing claims for a product that seem too good to be true, they probably are," says Steve Mister 🔗 https://www.crnusa.org/staff/steve-mister-esq-cae, president of US trade organisation the Council for Responsible Nutrition.

Users of social media platforms such as TikTok can create fads for products with little-to-no proven benefits. Consider a plant extract called berberine 🔗 /article/dn26615-calorie-burning-fat-boosted-by-medicinal-chinese-plant/. One user documented dramatic weight loss that she claimed was due to this supplement, resulting in it being dubbed "nature's Ozempic" – a reference to the prescription diabetes drug, which is also used for weight loss 🔗 /article/2371780-the-science-and-side-effects-of-the-drugs-ozempic-and-wegovy/. A close look at the scientific literature, however, reveals scant evidence that berberine can help people shed pounds.



Beyond Wegovy: Could the next wave of weight-loss drugs end obesity?

Wegovy and Ozempic have made headlines, but a new wave of more effective drugs like Mounjaro have the potential to end obesity altogether. How will they work and are they safe?

🔗 /article/mg25934470-900-beyond-wegovy-could-the-next-wave-of-weight-loss-drugs-end-obesity/

Even mainstream products from reputable retailers may lead consumers astray. Let's take a hypothetical "immunity boost" supplement. The label displays the word "echinacea" prominently, along with a picture of this plant. The problem is that, although echinacea has a reputation as a herbal medicine for improving the immune system, the evidence for its efficacy isn't yet sufficient to permit an authorised health claim, according to EFSA and the FDA. When you read the back of the box, however, you will find that the product includes vitamin C, for which the statement "contributes to the normal function of the immune system" is permitted. While that is factually true, it doesn't necessarily mean that this particular product will give your immune system a boost to protect you from your next cold or a bout of covid-19; it is simply stating vitamin C's role in the human body.

Often, the language on the labels is ambiguous enough to circumvent the regulations. "They say things on the packaging like 'Endurance' or 'Clarity'," says Cohen. "And it's like, 'Wow, that's really attractive. I want clarity, too.' And they don't need any science to back up those vague claims." For many botanical ingredients, there is scant evidence that they benefit our health in the way they are reputed to – and the evidence cited is often based on animal studies or human trials with just a few participants.

So what, if anything, actually does work? There is no doubt that supplements of vitamins and minerals have had incredible impacts on global health by resolving specific deficiencies, from scurvy (which arises from a lack of vitamin C) to neural tube defects (which can arise from a lack of folic acid). They can also be useful tools for tackling specific conditions. One recent success story is the supplement AREDS2 🔗 https://www.nei.nih.gov/learn-about-eye-health/eye-conditions-and-diseases/age-related-macular-degeneration/nutritional-supplements-age-related-macular-degeneration, which contains strong doses of vitamins C and E, as well as copper, zinc and the plant pigments beta carotene, lutein and zeaxanthin. Studies suggest it can slow down vision loss in people with more advanced stages of age-related macular degeneration, even though it doesn't prevent the early stages of the disease.

A healthy diet is by far the best source of essential vitamins and minerals

Juan Pablo Olaya Celis/shutterstock

The big question is whether supplements can give a boost to people without any particular illness or diagnosed deficiency. Some of the best-conducted studies have looked at multivitamin tablets containing a host of nutrients in one pill. The Physicians' Health Study 🔗 https://phs.bwh.harvard.edu/, for instance, followed nearly 15,000 men for 11 years and, in 2012, it found that multivitamins resulted in 🔗 https://jamanetwork.com/journals/jama/fullarticle/1380451 a "small but significant 8 per cent reduction in total cancer", says Manson. Unfortunately, a later study examining an even larger sample failed to detect a similar effect 🔗 https://cosmostrial.org/results/.

Such research shows that the effects of simply upping our dosage of basic essential nutrients are far from clear-cut. Last year, the US Preventive Services Task Force 🔗 https://www.uspreventiveservicestaskforce.org/uspstf/ – the independent body that makes evidence-based recommendations on disease prevention – conducted a meta-analysis of these trials and others, concluding that there was insufficient evidence to assess the balance of benefits and harms of multivitamins to prevent cancer or cardiovascular disease 🔗 https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/vitamin-supplementation-to-prevent-cvd-and-cancer-preventive-medication. It also advised against the use of beta carotene supplements, which appear to slightly increase the risk of lung cancer in people already susceptible. However, multivitamins may slow cognitive decline 🔗 /article/2337886-a-daily-multivitamin-could-keep-your-memory-sharp-as-you-age/.

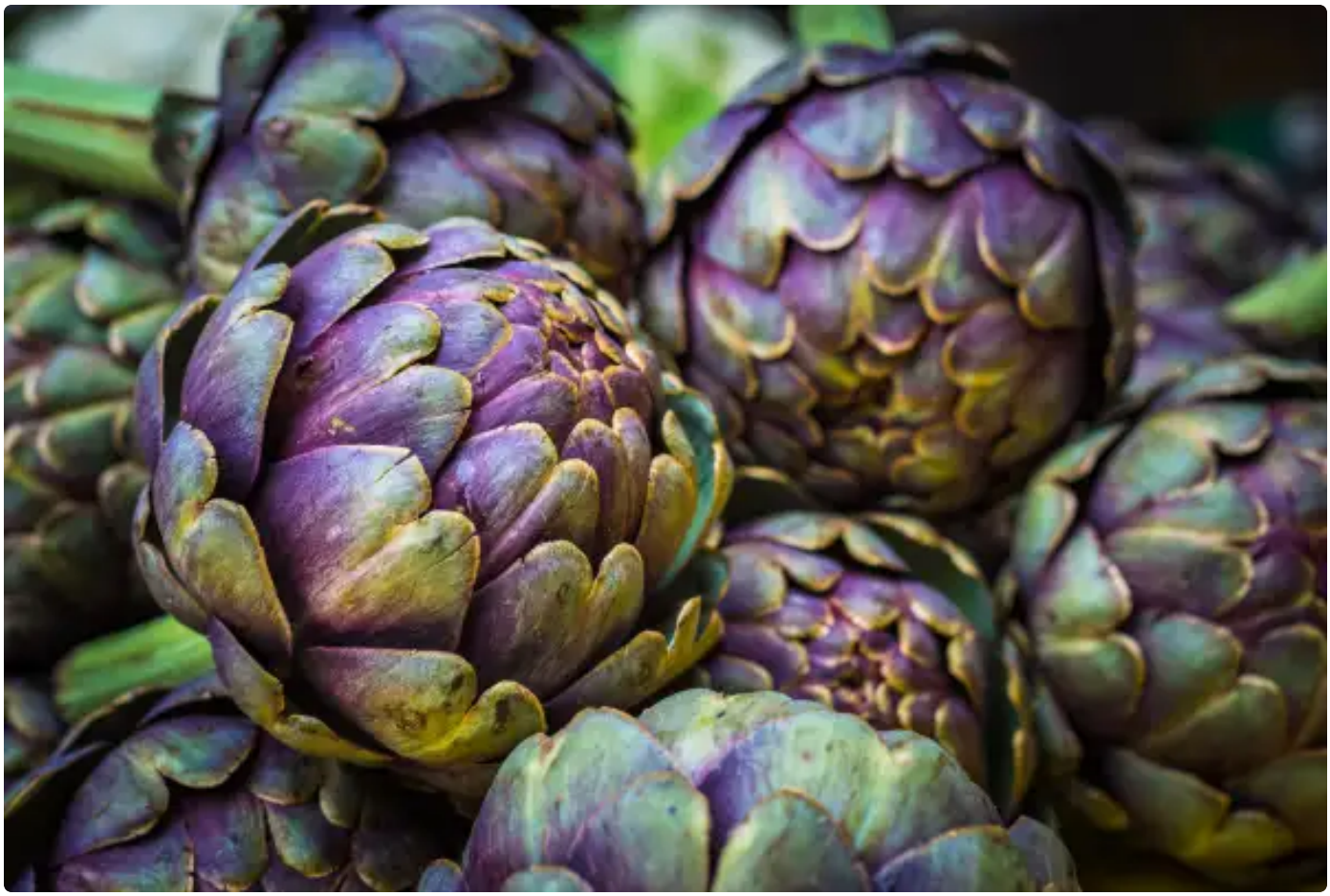
Many people who take supplements may already be getting the nutrients they need in their diet. If you eat lots of fruit and vegetables, fibre and fish each week, "the only thing that you might need is vitamin D", says Ruxton (this would depend on environmental sunlight levels and skin tone). If you really care about your health, you would do better to ensure you are eating such a diet before you decide to pop any pills. "Supplements can be complementary to a healthy diet, but they will never be a substitute for a healthy diet," says Manson.

Personalised nutrition

By averaging across huge swathes of the population, however, the large clinical trials may miss the benefits to smaller groups 🔗 /article/mg24732990-600-why-there-is-no-such-thing-as-a-healthy-diet-that-works-for-everyone/ of individuals who may be at risk of a particular nutrient deficiency and could therefore benefit from a helping hand. "Children, pregnant women, vegans, the elderly have specific needs," says Bernadette

Moore https://environment.leeds.ac.uk/food-nutrition/staff/7157/dr-j-bernadette-moore at the University of Leeds, UK (see "What do you really need?" #DeepDive-2). In the future, we may have "personalised nutrition", using blood samples or genetic testing to more precisely identify who may benefit from a concentrated dose of particular substances. To take one example, variants of the *MTHFR* gene https://www.cdc.gov/ncbddd/folicacid/mthfr-gene-and-folic-acid.html can change how people respond to different forms of vitamin B9 – the folic acid and folates that should be consumed during pregnancy.

Assuming that you are already meeting your basic dietary requirements, however, simply blasting your body with a "megadose" of a particular nutrient may provide no benefits and could even cause considerable harm. Turmeric supplements /article/2343736-turmeric-supplements-have-been-linked-to-liver-damage-in-five-people/, purported to have anti-inflammation effects but which show inconsistent results in clinical trials, have been linked to liver damage, for example, and vitamin A can be lethal at high doses. Taking too much vitamin D https://jamanetwork.com/journals/jama/fullarticle/2748796 has even been shown to reduce bone strength, since the higher doses may hinder hormones that promote bone formation. "If you're megadosing on a single nutrient, it could interfere with the absorption or bioavailability of others. It is generally not good practice to megadose," says Manson.



The food and drink that really can boost your immune system

Whether it is immune-boosting smoothies or bacteria-laden yogurts, there is a whole world of products that claim to improve your immune system – but these are the ones that actually work

/article/mg25734243-600-the-food-and-drink-that-really-can-boost-your-immune-system/

Such concerns are unlikely to stem the tide of new products, as tentative scientific discoveries quickly inspire new marketable goods. Just consider the explosion of interest in the amino acid taurine, after animal studies published in June /article/2377645-taurine-supplements-extend-lifespan-and-health-in-old-age-in-mammals/ revealed that it improved the health and lifespan of mice and monkeys.

That's not to mention the constant attempts to improve even our most basic vitamins. "The supplement sector is one of the most innovative sectors that exist in the area of food," says Patrick Coppens https://be.linkedin.com/in/patrick-coppens-5a72a3148 at Food Supplements Europe, a European industry body. A new, faster-acting form of vitamin D is currently being evaluated by European regulatory authorities and is already available in Australia. Mushroom powders with high levels of vitamin D have recently

gained EFSA approval, as has a new form of iron that mimics the natural form found in animals and plants, so is better absorbed by the body.

Such innovations may be impressive, but for now, you would do well to exercise a little critical thinking when tempted by a new product. You can ask your doctor if you are likely to have a particular deficiency and look online at some credible resources – such as fact sheets from the US National Institutes of Health Office of Dietary Supplements 🔗 https://ods.od.nih.gov/factsheets/list-all/ and assessments made by EFSA 🔗 https://www.efsa.europa.eu/en/publications, for instance – to find out the latest evidence behind the claims.

In many cases, you may find it is better to save your money or invest it in more fruit, vegetables and fish. Your body and your bank balance may be healthier as a result.

Lost in translation

In the world of food supplements, certain terms have become common. Mostly used by marketers, not nutrition scientists, none has an agreed definition.

Functional food: a food that has been formulated to contain some putative active ingredient with health benefits (even though a truly "functional" ingredient, with strong scientific evidence for its benefits, is rare).

Nootropics: over-the-counter dietary supplements marketed to improve memory and mental focus.

Nutraceutical: used to describe a food-derived product with purported health or medicinal benefits over and above its basic nutritional content

Superfood: a food that somebody is promoting for its believed benefits.

What do you really need?

Although many supplements (excluding vitamin D) aren't required for most people consuming a balanced diet, top-ups of the following nutrients are recommended for certain groups.

Folic acid: for pre-conception and for the first trimester of pregnancy.

Iron supplements: for people with iron-deficiency anaemia.

Long-chain polyunsaturated fatty acids: for those who don't consume oily fish weekly.

Vitamin B12: for vegans.

Alison George is a features editor at New Scientist