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Vitamin C And Optimal Immunity

Life Extension Magazine®

Issue: Nov 2015

The Link Between Vitamin C And Optimal Immunity

Most animals internally synthesize high amounts of vitamin C. Humans lack this ability and are entirely dependent on dietary or supplement ascorbate sources to remain alive. In addition to its vital role in maintaining the body's collagen structure, vitamin C augments numerous components of the immune system.

By Chad Robertson.

In 1937, the **Nobel Prize in Physiology** was awarded to Albert Szent-Gyorgyi for his research on **vitamin C**. At the time, vitamin C was a rare commodity and could only be extracted from adrenal glands or massive amounts of orange juice.

Szent-Gyorgyi's discoveries helped launch an onslaught of vitamin C research, especially into its ability to enhance immune function.

The human body does not produce vitamin C. It must be obtained from outside-the-body sources. Water-soluble vitamin C is quickly excreted.¹ That's why it makes sense to



supplement daily with vitamin C to ensure the body has the protection it needs.

Aging individuals tend to have lower levels of vitamin C circulating in their blood stream and immune cells.^{2,3} This can lead to impaired immune function.^{4,5}

While vitamin C helps maintain tissue and speed wound healing, an overlooked strength is its impact on boosting **immune function**. As you will read in this article, people with common diseases have lower vitamin C blood levels than healthy individuals.

With the growing body of data about the role that **plant-based nutrients** play in healthy aging, we sometimes forget about how much documentation exists in support of **vitamin C**, a nutrient found in small concentrations in certain plant foods.

New evidence is corroborating what scientists long ago advocated relating to the need for humans to maintain optimal vitamin C status.

The Importance Of Vitamin C

Vitamin C deficiency has been associated with frequency and duration of colds, along with immune system defects.⁶

While colds aren't usually dangerous in themselves, they can lead to pneumonia and other respiratory diseases, especially for aging individuals.⁷ Colds can be an

early indicator of gaps in immune function that could leave one vulnerable to a cascade of serious infections.

A deficiency of vitamin C broadly affects the various key aspects of immune function, which include the *innate system* we are born with, the *adaptive system* that develops from infancy to young adulthood, the cells that kill invaders, the cells that coordinate those attacks, and even the production



of antibodies that fight known infections.

As a result of vitamin C's wide-ranging impact on the immune system, a deficiency could leave us vulnerable to infections.⁵ A weakened immune system caused by low vitamin C levels can make any infection more serious. This danger becomes more ominous in older adults, in whom the phenomenon of *immunosenescence* (the aging of the immune system) already heightens risk.⁸

There are multiple causes of insufficient vitamin C. Aging is one major cause of lowered vitamin C levels.^{2,3} The concentration of vitamin C in immune cells decreases with age, partly the result of an increasingly oxidative environment that consumes vitamin C. This can lead to damage to DNA, proteins, and fat molecules needed for normal immune function.^{4,5}

Stress is another major trigger for reducing vitamin C levels, leaving the affected individuals vulnerable to infection at precisely the time that stronger immune support is needed.^{4,5,9}

In some remarkable human findings, low vitamin C blood levels have been associated with a number of common human diseases.^{5,10} The table below shows higher plasma vitamin C levels in healthy individuals compared to those with serious diseases, most notably cancer and sepsis.

TABLE: VITAMIN C LEVELS FALL IN MULTIPLE DISEASE STATES

Healthy Vitamin C Range is 61-80 mmol/L	
Vitamin C In Disease States	Mean Plasma Vitamin C Level (micromol/L)
Diabetes	42 mmol/L



Gastritis	46 mmol/L
Pancreatitis	33 mmol/L
Pneumonia	31 mmol/L
Cancer	< 24 mmol/L
Trauma or sepsis (overwhelming infection)	10 mmol/L
Arthritis	27 mmol/L

A healthy vitamin C level is considered to be between **61** and **80 micromol/L**. Those afflicted with serious diseases have much lower vitamin C levels. It is likely that the **inflammation** and **oxidative stress** caused by some of these diseases contributes to this reduced vitamin C since it will rapidly be used up quenching free radicals. It's also possible that lower levels of vitamin C contributed to the development or progression of some of these disorders.

Why The Immune System Depends On Vitamin C

One of the most important functions of vitamin C is to support and energize the body's immune system. Immune cells have active vitamin C transporter molecules embedded in their membranes that actively pump the vitamin into the cells when more vitamin C is required.^{5,11}

For example, during times of inflammation or infection, those transporters ramp up their activity to provide sufficient vitamin C to the cells' inner workings, causing cells to attain levels up to **100-fold** that of the plasma level. This is why blood levels of vitamin C drop during times of disease or infection (see Table above).^{5,11}



This can create a potentially vicious cycle in which, just when you need extra vitamin C, your body's stores are depleted. This also makes it especially important to increase one's intake of vitamin C when sick.

The content of vitamin C within immune cells is closely related to those cells' activity, especially in the case of specific cells that engulf and destroy infecting organisms (phagocytes) and of those that recruit, organize, and direct other immune cells (T-lymphocytes).¹¹

Fortunately, you can improve your immune system's function by supplementing with vitamin C.^{4,6,8,12} The recommended daily allowance of vitamin C is around **90 mg** per day. For optimal immune function, many experts now recommend supplementing with **1 gram (1,000 mg)** of vitamin C daily in addition to a diet rich in fruits and vegetables.¹³

Human studies have shown that this amount of vitamin C can not only reduce the duration and severity of the common cold—but can reduce the incidence of developing a cold as well. Not all common cold studies produce consistent results. This means more than vitamin C alone is needed to combat common colds, such as using the right dose of **zinc acetate lozenges** as soon as cold symptoms manifest.

WHAT YOU NEED TO KNOW

Vitamin C Supports The Immune System

- Older adults are at ever-increasing risk of serious infections or cancers as their immune systems age.
- An intact immune system relies upon many layers of protection from multiple cell



types and a host of immunologically active signaling molecules.

- The function of those specialized cells and molecules is being increasingly found to depend on adequate supplies of vitamin C in the body.
- Roughly **23%** of Americans have vitamin C depletion, causing their immune systems to not function properly.⁴⁴
- Studies show that doses of vitamin C at **1,000 mg** per day can effectively restore function to myriad components of the immune system.
- New studies confirm that vitamin C supplementation at **1,000 mg** per day shortens the duration and mitigates the severity of colds, while also preventing colds from developing, especially in those with low vitamin C levels.
- Take a **1,000 mg** per day supplement to optimize your immunity and potentially lengthen your life.

Reduce The Duration And Severity Of Colds

One of the best-known uses of vitamin C is in the prevention and treatment of the common cold.¹⁴ While for young people a cold is little more than a nuisance, in older adults, colds can herald the onset of serious bacterial infections such as pneumonia or bronchitis, both of which increase the risk of premature death.

There is no shortage of research demonstrating that vitamin C can reduce symptoms and shorten duration of the common cold.^{4,15} Studies show that vitamin C supplementation can reduce the **duration** of colds by anywhere from **5 to 21%**.¹⁵

Vitamin C supplementation has also been shown to significantly reduce the **severity** of cold symptoms. And in



older people who require hospitalization for pneumonia and chronic bronchitis, even a dose of just **200 mg** per day was shown to reduce the clinical severity of the illness.⁴

EMERGING AREAS OF VITAMIN C IMPORTANCE IN HUMAN HEALTH

This article primarily considered the role of vitamin C in supporting the immune system, particularly in aging or stressed individuals. There is growing support, however, for use of vitamin C in these other areas as well:



- **Diabetes:** Diabetes induces powerful oxidant stress throughout the body, leading to inflammation and loss of function. Studies now show that vitamin C status may influence the incidence of type II diabetes, the accelerated cognitive decline of diabetics, the anxiety, depression, and stress experienced by diabetics, and the risk of atrial fibrillation in diabetics.⁴⁵⁻⁴⁸
- **Cardiovascular disease:** Heart disease and stroke have many causes, but oxidant damage and inflammation lead the pack.⁴⁹⁻⁵³ Studies now show vitamin C improves endothelial function (function of the active lining of blood vessels that controls blood flow and pressure) and potentially other areas of cardiovascular medicine.⁵⁴⁻⁵⁶
- **Periodontal disease:** Bleeding gums and tooth loss were common symptoms of scurvy that were readily reversed with vitamin C supplementation. Today's scientists are demonstrating a role of vitamin C in preventing less obvious, but still important causes



of tooth loss in older adults, such as gingivitis.⁵⁸

- **Osteoporosis:** Vitamin C is an absolute requirement for normal formation of bone proteins, and preliminary studies are showing the potential of the vitamin in preventing bone loss and fractures related to osteoporosis.^{59,60}

Vitamin C Reduces Incidence Of Colds

While the evidence demonstrating the ability of vitamin C to reduce the duration and the severity of colds is clear, the question of whether vitamin C supplementation could also reduce the **incidence** (rate of occurrence) of colds has been fiercely debated.¹⁶ Newer studies using higher doses of vitamin C show that vitamin C can, in fact, reduce the incidence of colds.

Studies using **1,000 mg** or more have shown that vitamin C reduces cold incidence by a remarkable **50%** among people undergoing heavy stress, such as soldiers and athletes.^{4,15,17}

These studies found that the people who had the lowest dietary intake of vitamin C had the greatest benefit.

In **2014**, a study of vitamin C published in the journal *Nutrients* provided definitive evidence that vitamin C supplementation can reduce the incidence of the common cold in otherwise healthy people with chronic stress or obesity.⁶ The study included 18- to 35-year-old men who had vitamin C levels of less than **45 micromol/L** (**61 to 80** is considered adequate). The study lasted eight weeks, and scientists recorded scores on a physical activity scale and tracked the occurrence of cold episodes.

During the study, **85%** of placebo recipients experienced a cold compared with just **47%** of supplemented subjects, a statistically significant difference and a risk reduction of



45%.⁶

Reduction in cold duration was also significant in the supplemented versus the control group, with supplemented subjects experiencing an average of **3.2 (59%)** fewer days with cold symptoms than placebo subjects. Intriguingly, supplemented subjects' physical activity scores also rose by **40%** compared with placebo recipients, strongly suggesting that supplementation was correcting hidden symptoms of vitamin C depletion, such as fatigue and malaise.

Even more impressive, at least three controlled studies also show that vitamin C supplementation can reduce the incidence of **pneumonia** by as much as **80%**.¹⁵ This is a crucial finding for older adults since the death rate for elderly people with pneumonia exceeds **16%**, even with antibiotic treatment, highlighting the urgency of prevention.^{18,19}

Vitamin C And Immunity: Details From Laboratory Studies

The aging of the immune system (*immunosenescence*) can leave older individuals vulnerable to infection and disease that wouldn't be an issue for younger people.²⁰ Laboratory studies indicate that vitamin C can restore an aging immune system to that of younger individuals.

An abundance of laboratory studies show that vitamin C can boost immune function, particularly in older people. One particular study demonstrates this perfectly. White blood cells from elderly people typically perform poorly in response to stimulation by foreign material (antigens). However, a study published in the *International Journal of Immunopharmacology* showed that incubating these white blood cells overnight in a solution enriched with vitamin C restored the performance levels of these cells to that of normal cells from younger people.⁸

In fact, vitamin C produces beneficial effects on virtually all of



the immune system's cells.

- **Natural killer (NK) cells.** These “hit men” of the immune system move in on infectious and malignant targets that have been identified as foreign by other immune system components. Like other immune cells, NK cells' function declines with aging.²¹ Detailed scientific studies show that NK function improves in the presence of adequate vitamin C, and declines without it.²²⁻²⁴ Vitamin C helps NK cells track and destroy tumor cells as well by reducing the shielding effect of platelets (blood clotting cell fragments) that would prevent NK cells from destroying them. This effect may help to prevent cancers from producing deadly metastases.²³
- **Neutrophils** are the main immune system cell for fighting bacterial infections. Neutrophils engulf invading organisms, then destroy them with powerful blasts of short-lived oxygen free radicals. Vitamin C supports many aspects of neutrophil function, aiding in their ability to chase down bacterial targets and improving their ability to engulf and kill such targets.^{25,26} Since the bacterial killing process creates potent oxidation products, neutrophils would destroy themselves in short order without ample vitamin C, which scavenges up the dangerous oxidizing molecules once they have done their work to destroy the bacterial cell.²⁵⁻²⁷

A study published in the *Canadian Journal of Physiology and Pharmacology* showed that when human volunteers took an oral dose of **1,000 mg** or more of vitamin C, neutrophils performed more vigorously than those of unsupplemented subjects.²⁸ Improved function of neutrophils in the presence of



adequate vitamin C is so evident that clinicians have begun to use vitamin C at **1,000 mg** per day doses for people with **chronic granulomatous disease**, a disorder in which neutrophils lack proper killing ability once they have ingested bacteria.^{26,29} Similar improvements in neutrophil performance have been shown in the much larger population of people with asthma, another condition in which neutrophil impairment can worsen patients' clinical status.²⁶

- **Lymphocytes** are immune system cells that produce antibodies (called **B-lymphocytes**) and coordinate with other immune cells to guide them towards threats needing destruction.^{8,30} When they detect such an incipient threat, lymphocytes rapidly reproduce in a proliferative response that is enhanced in the presence of vitamin C. In older adults, that proliferation is impaired, but vitamin C treatment restores them to youthful levels of function.^{8,31} Similar enhancements of lymphocyte proliferation have been demonstrated by supplementing aging laboratory animals with vitamin C, which also boosts lymphocytes' ability to track down threats.³²

Diabetes, like aging, impairs the production of lymphocytes and the functioning of T-lymphocytes.^{33,34} However, supplementing diabetic rats with vitamin C pushed lymphocyte production from **57%** of that of controls to virtually **100%** of control values, essentially creating "nondiabetic" immune cells within a living diabetic body.³⁵

- **Antibodies** are noncellular components of the immune system that help identify and destroy invading threats and cancerous cells.³⁶ Vitamin C benefits this portion of the immune system by raising levels of three main classes of antibody immunoglobulins: **IgA**, which



protects against infections mainly on mucosal surfaces, such as the respiratory and digestive tracts, **IgG**, which provides long-term protection in the bloodstream, and **IgM**, which is the earliest immunoglobulin to appear in blood in response to threats.³⁷⁻⁴⁰ Blood levels of antibodies and other protective molecules rose significantly when volunteers took **1,000 mg** doses of vitamin C daily for 75 days, demonstrating the effect in humans.⁴¹

Human Studies Confirm Vitamin C's Immune Benefits



There is now copious evidence that vitamin C benefits people with impaired immune function, whether that impairment is the result of disease or simply of aging.

In patients with frequent skin infections, for example, who had known impairment in **neutrophil** tracking and killing of microorganisms, vitamin C was as effective as a powerful immune-regulating drug, *levamisole*, at improving neutrophil function and producing long-lasting remission.⁴² But unlike levamisole, which produced severe side effects causing **8%** of subjects to drop out of the study, no patients in the vitamin C arm dropped out. Similar improvements in neutrophil function, and dramatic clinical recoveries, were seen in patients with recurrent furunculosis (boils), on a dose of **1,000 mg** per day.⁴³

This same dose of vitamin C was found to boost immune cell functions in women who were an average of 72 years old.²⁸ In this study, lymphocyte and neutrophil function improved in all members of this group, including those who were healthy, those with major depression, and those with coronary heart disease. This study demonstrated the far-reaching effects of



vitamin C in the aging body.

Summary

Few people realize the importance of having ample supplies of water-soluble vitamin C in their body.

Without regular ingestion, ascorbic acid (vitamin C) levels drop rapidly and can produce hidden effects, long before major signs of scurvy appear. Otherwise unexplained fatigue, malaise, or “mind fog” may in reality be symptoms of vitamin C depletion.

All major immune system cell lines function at their peak with ample vitamin C supplies. With inadequate intake or plasma levels, those cells are less able to detect, track, and kill invading organisms or precancerous cells. That means that vitamin C depletion can leave one vulnerable to dangerous infections.

New studies are helping to confirm that vitamin C supplementation can reduce duration and severity of the most prevalent respiratory infection, the common cold, and makes it less likely one will catch a cold in the first place.

Given the health risks associated with adults who develop pneumonia after a cold, prevention with adequate **vitamin C (1,000 mg** and higher daily doses) looks more promising. This dose, greater than what can fit into most multi-nutrient formulas, will assure you are obtaining sufficient vitamin C to emulate studies documenting improved immune function, protection against the common cold, and other age-related disorders.

If you have any questions on the scientific content of this article, please call a **Life Extension®** Wellness Specialist at 1-866-864-3027.

Editor's Note



Science continues to evolve, and new research is published daily. As such, we have a more recent article on this topic:

Vitamin C: Critical Role in Immune Health

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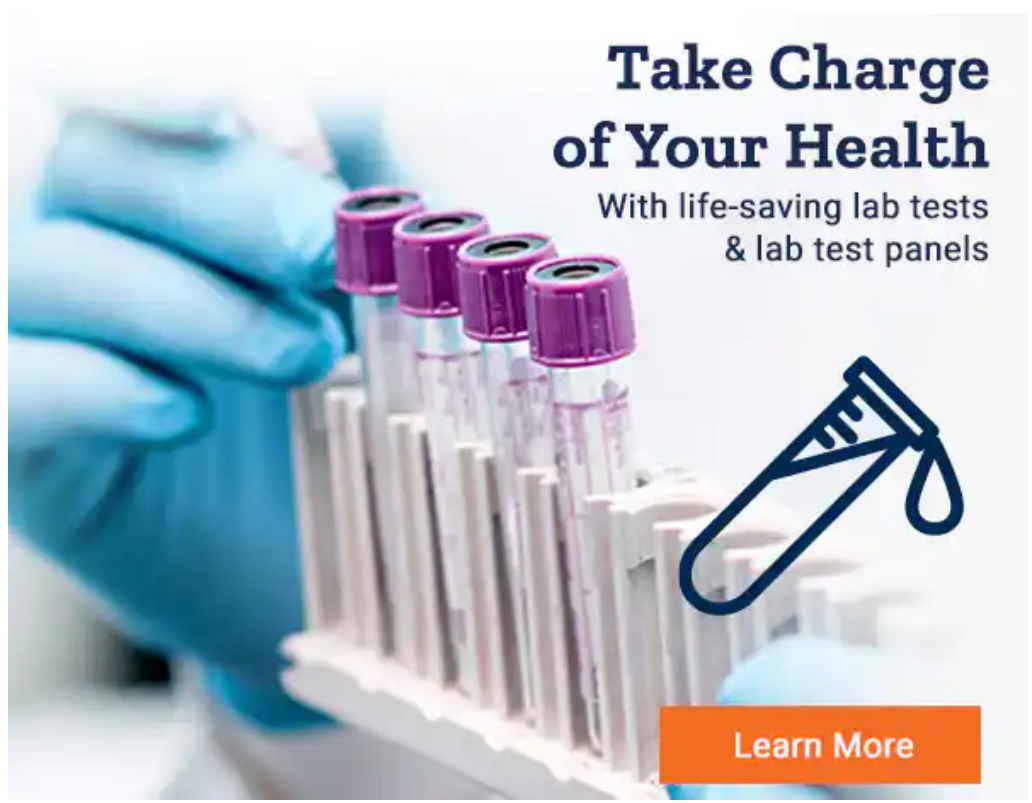
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Ratings based on results of the 2021 and earlier ConsumerLab.com surveys of supplement users.

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