

LE Magazine April 2008

REPORT

Newly Discovered Health Benefits of Vitamin C

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Vitamin C is rapidly finding new applications in protecting against endothelial dysfunction, high blood pressure, and the blood vessel changes that precede heart disease.¹⁻³ Additional research is discovering that vitamin C can be helpful in preventing asthma,⁴ protecting against cancer,⁵ and supporting healthy blood sugar levels in diabetics.⁶

While often taken for granted, vitamin C is a critical supplement in your program to improve cardiac health and avoid degenerative diseases.

VITAMIN C—BREAKTHROUGHS IN CARDIOVASCULAR HEALTH

One of the most intensely studied areas of vitamin C benefits is in the area of cardiovascular health. Researchers are finding that vitamin C impacts several aspects of cardiac health, ranging from blood pressure to endothelial health. Perhaps it's not surprising that as the relationship between oxidative damage, inflammation, and atherosclerosis becomes increasingly investigated by science, vitamin C is seen as a key protective element against many aspects of cardiovascular disease.

For years, scientists have warned us against the dangerous buildup of plaque that can lead to a heart attack or stroke. Researchers are investigating the possibilities that vitamin C may play a role in reducing our risk of plaque buildup.

In the early stages of atherosclerosis, white blood cells called monocytes migrate and stick to the walls of the endothelium. Once this process begins, our vessel walls begin to thicken and lose their elasticity, which paves the way for atherosclerosis.

Interestingly, British researchers studied the effects of vitamin C supplementation (250 mg/day) on this adhesion process in 40 healthy adults.⁷ Before the study, subjects with low pre-supplementation levels of vitamin C had 30% greater monocyte adhesion than normal, putting them at higher risk for atherosclerosis. Impressively, after six weeks of supplementation, the rate of this dangerous monocyte adhesion actually fell by 37%.

The researchers went on to demonstrate that the same small dose of vitamin C was able to normalize a molecule that white blood cells use to adhere to the endothelium.⁸ The findings indicated that through supplementation with vitamin C, scientists were able to regulate how specific genes produce vital proteins, thereby reducing the risk of cardiovascular disease at the molecular level.

Building on this important work, scientific researchers in 2005 studied the impact of antioxidant supplementation on degenerative aortic stenosis, an age-associated heart valve disorder that has an inflammatory component.⁹ The scientists studied 100 patients with mild-to-moderate aortic stenosis, randomly assigning 41 of them to receive vitamins C (1,000 mg/day) and E (400 IU/day), 39 to receive vitamin C only (1,000 mg/day), and 20 to serve as untreated controls. Both supplemented groups experienced significant reductions in levels of several important adhesion molecules, potentially reducing further inflammatory damage to the heart valves.

And just as vitamin C helps preserve vascular integrity, it is also proving beneficial in combating other risk factors for endothelial dysfunction and cardiovascular disease.



- Ascorbic acid, or vitamin C, is a potent antioxidant with increasingly diverse uses in health promotion and disease prevention.
- Every step in the progression of atherosclerosis can benefit from the antioxidant power of vitamin C, from preventing endothelial dysfunction and altering lipid profiles and coagulation factors to preventing blood vessel changes that can lead to strokes and other vascular catastrophes.
- Vitamin C supplements reduce cellular DNA damage that is the vital first step in cancer initiation and also reduce the inflammatory changes that allow a malignant cell to grow into a dangerous tumor.
- Vitamin C supplements enhance the health-promoting effects of exercise and reduce exercise-induced oxidative damage.
- Vitamin C supplements also dramatically combat the oxidative damage caused by smoking and exposure to tobacco smoke.
- In respiratory conditions, vitamin C supplements help avert or shorten the duration of common colds and may mitigate the risk of serious respiratory conditions like asthma.
- Vitamin C supplements can speed the clearance of the stomach disease-causing bacterium *Helicobacter pylori* and cut the risk of gastric cancer it causes.

LIPID PROFILES, BLOOD PRESSURE, AND BODY MASS INDEX

Most people have learned to pay attention to the amount and kinds of fats and cholesterol in their blood (lipid profiles), their blood pressure, and their body mass index (BMI), the most meaningful measure of how weight and health are related. This group of parameters not only influences endothelial function but is instrumental in laying down atherosclerotic plaque, helping set the stage for atherosclerosis.

Data from just the past few years reveal that vitamin C plays an important role in helping to prevent such a scenario.

In 2000, British researchers reported a six-month, double-blind study of vitamin C 500 mg/day versus placebo in 40 men and women, aged 60-80 years.² The study was a “crossover” design in which subjects took the assigned pills for three months, stopped them for one week, and then reversed their assignments for another three months; this is a particularly strong study design because it helps to eliminate individual differences. The results were impressive—daytime systolic blood pressure dropped by an average of 2 mm Hg, with the greatest drop seen in subjects who had the highest initial pressures. Women in the study also had a modest increase in their beneficial high-density lipoprotein (HDL) levels. The authors concluded that these effects might “contribute to the reported association between higher vitamin C intake and lower risk of cardiovascular disease and stroke.”



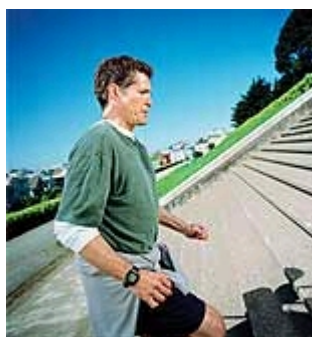
Researchers in South Carolina conducted a 2002 study of 31 patients with a mean age of 62 years, who were randomly assigned to take 500, 1,000, or 2,000 mg of vitamin C daily for eight months.¹⁰ This research group actually found a drop in both systolic (4.5 mm Hg) and diastolic (2.8 mm Hg) blood pressure over the course of supplementation, although there was no change in blood lipid levels. Interestingly, this study found no differences between the groups taking the various doses, though the number of subjects was small and a larger study might have demonstrated important dose-related differences.

Body mass index (BMI) and waist circumference correlate well with risk for cardiovascular diseases and diabetes.¹¹ A landmark 2007 study from nutritionists at the University of Arizona explored the relationships between vitamin C levels, body mass index, and waist circumference.¹² In 118 sedentary, non-smoking adults, 54% of whom were classified as obese and 24% overweight by BMI standards, lower vitamin C levels were significantly correlated with higher BMI, percentage of body fat, and waist circumference. Women with higher vitamin C levels also had higher levels of the fat-suppressing hormone, adiponectin. This remarkable study demonstrated a vital relationship between vitamin C levels and obesity-related risk factors for cardiovascular disease.

VASCULAR STIFFNESS AND COAGULATION

The development of atherosclerosis involves dysfunction of the vascular endothelium. As plaque accumulates and as vessel walls

thicken, blood vessels become increasingly stiff, making them less able to participate in blood pressure control and to deliver appropriate amounts of blood flow. Endothelial dysfunction increases the tendency for arterial blockage due to a blood clot, or thrombosis. Like several other “atherogenic” changes, these effects are related to the impact of free-radical damage.¹³ Vitamin C’s antioxidant characteristics are showing great power in reducing or even reversing some of these ominous vascular changes.



Medical researchers explored the impact of vitamin C supplements on both arterial stiffness and platelet aggregation (an important early step in clot formation).¹³ They provided vitamin C in a single 2,000 mg oral dose, or placebo, to healthy male volunteers. Just six hours after supplementation, measures of arterial stiffness decreased by 10% in the supplemented group, and platelet aggregation (as stimulated chemically) by 35%, with no changes at all seen in the placebo group. As the authors point out, this impressive impact of vitamin C even in healthy subjects may imply an even greater effect in patients with atherosclerosis or cardiovascular risk factors, and that “vitamin C supplementation might prove an effective therapy in cardiovascular disease.”

Many other studies have further advanced our understanding of how vitamin C might reduce atherosclerosis risk factors.^{1,8,14-16} Finnish researchers studied 440 adults aged 45-69 years with elevated total serum cholesterol.³ Subjects took daily doses of just 500 mg slow-release vitamin C and 272 IU vitamin E and were followed for six years for evidence of progression of atherosclerotic changes in blood vessels. The chief study outcome was the intima-media thickness, or IMT (an indicator of stroke risk) of the carotid arteries, which supply blood to the brain. Supplementation with vitamins C and E significantly decreased the rate of IMT increase over the six-year period by 26%. Importantly, this effect was even larger in people with low baseline vitamin C levels and those with pre-existing plaques in their coronary arteries. In other words, supplementation seemed to provide the greatest benefit to those with the greatest need. This study shows that supplementation with vitamin C slows down the progression of stroke-inducing atherosclerosis.

MAXIMIZING HEALTHY LIFESTYLE CHOICES

In our efforts to reduce the risk of heart disease, regular exercise plays an important part in maintaining a healthy lifestyle. The increased delivery of oxygen-rich blood to tissues is a vital part of the process—but it can also produce destructive free radicals.¹⁷ Clearly, the solution is not to stop exercising! Rather, a series of recent studies shows how supplementation with vitamin C can mitigate free-radical damage from intense exercise.

British researchers evaluated the effects of just two weeks of modest vitamin C supplementation (200 mg twice daily) on the recovery from an unaccustomed bout of exercise.¹⁸ Eight healthy men were given either a placebo or vitamin C supplementation each day, and after 14 days performed a 90-minute-long running test. The supplemented group had less muscle soreness, better muscle function, and lower blood levels of the oxidative stress-induced molecule malondialdehyde. And although both groups experienced post-exercise elevations in levels of the inflammatory cytokine interleukin-6, increases in the supplemented group were smaller than in the placebo recipients. The scientists concluded that “prolonged vitamin C supplementation has some modest beneficial effects on recovery from unaccustomed exercise.”¹⁸ Timing is critical, however. When the researchers repeated their study with subjects who took vitamin C only after exercise, no benefit was seen.¹⁹

Oxidative stress during exercise induces significant changes in proteins, producing compounds known as protein carbonyls.²⁰ Measuring levels of protein carbonyls is therefore a useful indicator of oxidation.²¹ Exercise scientists at the University of North Carolina studied the impact of vitamin C supplementation (500 or 1,000 mg/day for two weeks) compared with placebo on oxidative stress indicators in 12 healthy men.²² As expected, exercise acutely reduced total blood levels of antioxidants in both groups. Levels of protein carbonyls increased by nearly four-fold in the placebo group, while vitamin C recipients experienced little or no elevation. This vital study demonstrates that vitamin C can protect against exercise-induced protein oxidation in a dose-dependent fashion.

Muscle soreness after exercising can be a big disincentive to continue on a healthy fitness program. That’s why the subsequent findings of that UNC group are so important. The scientists gave vitamin C supplements (3,000 mg/day) or placebo to a group of 18 healthy men for two weeks before and four days after performing 70 repetitions of an elbow extension exercise.²³ Not surprisingly, considerable muscle soreness ensued, but it was significantly reduced in the supplemented group. The release of creatine kinase, an indicator of muscle damage, was also attenuated with vitamin C, compared with the placebo group. Blood levels of natural antioxidants fell significantly in placebo subjects, while vitamin C supplementation completely prevented this change. Results such as these suggest that the supplemented group would be much more enthusiastic about exercising the next day!

MINIMIZING UNHEALTHY LIFESTYLE CHOICES

Vitamin C may offer important protective benefits for smokers and those who are passively exposed to tobacco smoke. Smoking has been linked with elevated levels of C-reactive (CRP) protein, an inflammatory marker linked with an elevated risk of cardiovascular disease. As Life Extension readers know, it is crucial to monitor your CRP levels through regular blood testing and

to keep your CRP under control in order to limit cardiovascular problems. Fortunately, vitamin C has been shown to play a role in helping to combat excessive CRP levels.

Researchers in Berkeley evaluated the impact of antioxidant supplementation on blood levels of CRP in both active and passive smokers.²⁴ They studied 160 healthy adults who were actively or passively exposed to cigarette smoke and randomly assigned to receive placebo, vitamin C (515 mg/day), or an antioxidant mixture (including vitamins C, E, and lipoic acid). Subjects in the vitamin C group underwent a significant 24% reduction in their plasma CRP concentrations, while neither of the other groups showed a significant change. This remarkable result provides strong support for chronic supplementation with vitamin C, whether or not you smoke.

Smoking causes cancer in part by directly damaging DNA, which is a vital first step in the onset of cancer. In studying the effect of vitamin C supplements on reducing DNA damage in blood cells, Danish researchers gave relatively low doses (500 mg/day) of vitamin C as plain-release or slow-release tablets combined with vitamin E (182 mg/day), or placebo, for four weeks to a group of male smokers.²⁵ The slow-release formulation of vitamin C reduced the number of DNA damage sites measured in white blood cells just four and eight hours after a single tablet, a positive result that was still evident at four weeks. The plain-release tablets also exerted a protective effect at four hours, suggesting benefits of long-term vitamin C supplementation in minimizing DNA damage.

Once DNA is damaged, however, smoking induces pro-inflammatory changes that can allow a malignant cell to become a dangerous tumor as well as causing blood vessel damage associated with atherosclerosis. Vitamin C supplementation is a logical approach to reducing the impact of these inflammatory changes, as was shown recently by a British investigative team.¹⁵ They studied 10 smokers with the high-risk lipoprotein ApoE4 gene as well as 11 non-smokers, all of whom took just 60 mg/day of vitamin C for four weeks. Remarkably, these high-risk smokers on this low-dose regimen responded with a marked reduction in levels of a host of pro-inflammatory cytokines. As the authors themselves pointed out, this study identified core molecular mechanisms that help explain the known benefits of vitamin C supplementation in smokers.

Literally scores of other studies have been published demonstrating the benefits of vitamin C supplements in smokers and those passively exposed to cigarette smoke. One study found that 500 mg of vitamin C twice daily for just two weeks reduced the depletion of vitamin E caused by smoking by up to 50%.²⁶

Two other studies investigating low and high doses of vitamin C supplementation revealed its benefits in improving endothelial function, a cornerstone of cardiovascular health, known to be impaired in smokers. The first study showed that just 60 mg of vitamin C daily given to a group of smokers for 12 weeks improved endothelial function as assessed by flow-mediated vasodilation.²⁷ In the second study, Dutch researchers found that 2,000 mg/day of vitamin C for two weeks reversed endothelial dysfunction caused by the abnormal migration of monocytes⁷ implicated in atherosclerosis.²⁸

Furthermore, Berkeley public health researchers successfully reduced levels of F2-isoprostanes, a sign of oxidative stress and cell damage, in a group of 67 passive smokers who were given vitamin C supplements daily for two months. The researchers stressed the value of these findings in preventing tobacco smoke-induced health damage in non-smokers.¹⁴

VITAMIN C AND THE IMPORTANCE OF ANTIOXIDANTS

Oxidative damage and the resultant inflammatory changes are now known to lie at the root of most common chronic conditions in humans, such as cardiovascular disease and cancer.^{5,35,48-51} Although for many years it was thought that tissue ischemia (lack of oxygen-rich blood) caused the damage from acute conditions such as myocardial infarction (heart attack) and stroke, today we recognize instead that it is the sudden restoration of vital oxygen and the consequent production of reactive oxygen species that wreak major havoc on surviving tissue.⁵² This so-called ischemia/reperfusion injury is also now recognized as a critical factor in brain injury following bleeding and head trauma.⁵³

Reactive oxygen species are harmful in other ways as well—they contribute to the DNA damage that is the first step in converting healthy cells into malignant cancers^{54,55} and they impair many of the checks and balances inherent in our immune systems, rendering us potentially vulnerable to deadly infections and their consequences.^{56,57} Finally, healthy lifestyle choices such as exercise^{17,18} and unhealthy activities such as smoking and excessive alcohol consumption^{14,24,58} produce reactive oxygen species that must be controlled to prevent tissue injury. Scientists studying all of these conditions are rapidly developing a strong appreciation for vitamin C's powerful potential as a preventive and often therapeutic supplement.

OTHER RECENT ADVANCES IN VITAMIN C THERAPY

Nutritional researchers are constantly uncovering new health benefits for vitamin C. Recent findings include vitamin C's role in the following applications:

Respiratory illnesses: The impact of vitamin C in staving off the common cold has been hotly debated for more than three decades. Large, well-designed studies continue to show, however, that regular vitamin C supplements reduce the frequency²⁹ and duration of the common cold.³⁰ More serious illnesses also benefit from the antioxidant effects of vitamin C, particularly asthma.³¹⁻³³ Asthmatic children given an antioxidant supplement containing 250 mg vitamin C and 50 mg vitamin E had markedly decreased responses to environmental asthma triggers.⁴ And vitamin C supplements (1,000 mg/day) also reduced the amount of long-term inhaled corticosteroids needed by adults with asthma.³⁴

Cancer: Exciting new work is showing that vitamin C supplementation may decrease the toxic effects of chemotherapy drugs (such as damage to heart tissue)³⁵ and increase the anti-tumor activity of chemotherapy.³⁶ Further, promising studies show that vitamin C may synergize with other antioxidant and anti-inflammatory nutraceuticals to help fight cancer.^{37,38} Chronic supplementation with vitamin C and other antioxidants might also serve a vital chemopreventive role, reducing the risk of actually developing cancer in the first place.^{5,39-41}

Diabetes: Human studies have now demonstrated that vitamin C supplements may help lower blood glucose levels in diabetics, with additional beneficial reductions in low-density lipoprotein (LDL) and plasma free radicals.^{6,42}

Stomach Health: Supplementing with vitamin C can also protect against oxidative damage wrought by the bacterium *Helicobacter pylori*, a major cause of gastritis and stomach ulcers. Vitamin C supplements can also reduce the dose of antibiotics needed to eradicate the organism^{39,43} and may directly prevent the gastritis it causes.⁴⁴ And there's encouraging evidence that higher vitamin C levels are associated with lower long-term gastric cancer risk.⁴⁵

SUPPLEMENTING WITH VITAMIN C

The recommended intake to prevent overt vitamin C deficiency is 90 mg/day for men and 75 mg/day for women who do not smoke; for smokers, 125 mg/day for men and 110 mg/day for women are recommended. Clinical studies suggest that the amount of vitamin C required for optimal health is at least 400 mg/day, with some studies suggesting doses as high as several thousand milligrams daily.⁴⁶ Many health practitioners recommend supplementing with at least 1,000 mg of vitamin C daily.

While vitamin C is generally considered safe and well-tolerated, a few words of caution apply. Individuals who have certain hematologic disorders such as thalassemia, anemia, or glucose-6-phosphate deficiency should consult a physician before supplementing with vitamin C, as should pregnant or nursing women.⁴⁷

SUMMARY

Modern science is now eagerly embracing vitamin C's enormous potential as an antioxidant capable of preventing and, in some cases, reversing a host of human ills. Helping to maximize the beneficial effects of exercise while minimizing the impact of destructive toxins like tobacco smoke, vitamin C also acts at the most fundamental levels to prevent endothelial changes that lead to atherosclerosis, while also blocking harmful DNA degradation that triggers malignant change and sets the stage for cancer. And as scientists learn still more about the vital role of oxidative damage in diseases ranging from asthma to stomach ailments, vitamin C's importance is growing literally by the day. There is no doubt that future research will uncover even more astonishing findings on the health benefits of vitamin C.

If you have any questions on the scientific content of this article, please call a Life Extension Health Advisor at 1-800-226-2370.

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