

High-Dose Supplemental Vitamin C on Immune Function and Infection

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What is Vitamin C?

Vitamin C (ascorbic acid) is:

- A water-soluble vitamin that naturally exists in foods, such as certain fruits and vegetables, and can be made into supplement form (National Institutes of Health, 2020)
- An antioxidant that donates its electrons to free radicals (unstable molecules) to prevent damage to fats, proteins, and DNA (oxidative stress)
- A helper for enzymes involved in significant bodily processes such as the biosynthesis of collagen (Padayatty & Levine, 2016)
- A potent antiviral (Carr & Maggini, 2017)

Immune Functions of Vitamin C

- Helps with function and development of white blood cells
- Promotes the movement of certain cells, such as phagocytes, towards infection sites to engulf harmful microbes
- Promotes natural cell death and the clean up of used neutrophils from sites of infection, thus decreasing the risk of cell and tissue death caused by disease
- Protects the skin from environmental toxins through antioxidant activity (Carr & Maggini, 2017)

Why High-Dose Vitamin C?

- 200 mg or more of vitamin C given orally or intravenously (IVC)
- Humans cannot make or store vitamin C (Hickey et al., 2005)
- Current RDA of 90 mg/day for men and 75 mg/day for women is too low: research suggests RDA should be 200 mg/day or higher (Levine et al., 1996)
- Research shows that bowel tolerance (amount of Vitamin C a person can take before loose stool occurs) increases with severity of disease (Cathcart, 1981)

CONDITION	USUAL BOWEL TOLERANCE DOSES (Cathcart, 1981)	
	GRAMS PER 24 HOURS	NUMBER OF DOSES PER 24 HOURS
normal, well	4 - 15	4
mild cold	30 - 60	6
severe cold	60 - 100	8
influenza	100 - 150	10
ECHO, coxsackie virus	100 - 150	8
mononucleosis	150 - 200+	12
viral pneumonia	150 - 200+	12
hay fever, asthma	15 - 25	4
burn, injury, surgery	25 - 150	6
anxiety, exercise and other mild stresses	15 - 25	4
cancer	15 - 100	4
ankylosing spondylitis	15 - 100	4
rheumatoid arthritis	15 - 100	4
bacterial infections	30 - 200+	10

The Center for Better Bones & Alkaline for Life® on High-Dose Vitamin C

The Center for Better Bones & Alkaline for Life® research the vast functions of vitamin C and promotes high-dose vitamin C (about 5000 mg/day of fully reduced, fully buffered ascorbate) in order to:

- Help alkalinize tissue pH in the body
- Optimize bone health
- Promote immune system function (Alkaline for Life, 2017)



(Alkaline for Life, n.d.)

At the Center for Better Bones & Alkaline for Life®, helped promote high-dose vitamin C by researching and writing and editing blogs with certified nutritionist, Dr. Susan Brown, for their website:

- “Low-Dose vs. High-Dose Vitamin C: Why 500 mg is not enough!”
- “Ascorbate vs. Ascorbic Acid: Is there a difference?”
- “9,000 Cases of Healing with High-Dose Vitamin C”
- “Our Simple Vitamin C Quiz – Are You Deficient?” (Alkaline for Life, 2020)

Key Findings from Literature

Vitamin C on Influenza

Influenza affects the body by creating oxidative stress which causes damage to lung tissue and inflammation of the lungs (Zarubaeva et al., 2018)

- Ascorbic acid is an antioxidant, so it protects against the flu by:
 - Donating electrons to free radicals
 - Stopping certain enzymes from enabling the transfer of the virus

Study: (Gorton & Jarvis, 1999)

- Control group: 463 participants, ages 18 to 32
- Experimental group: 252 participants, ages 18 to 30
- Number of cold and flu symptoms of participants for one year were recorded
- Control group: pain killers and cold medicine when symptoms appeared
- Experimental group: 1,000 mg of vitamin C for first 6 hours after symptoms appeared, and then three times daily
- Flu and cold symptoms in experimental group decreased 85% after vitamin C flu compared to the control group

Vitamin C and Pneumonia

- Experimental studies show vitamin C increases function of phagocytes and production of specific white blood cells and interferon (proteins), and prevent viruses from replicating (Hemila & Louhiala, 2007)
- Pneumonia results in reduced vitamin C levels in plasma, leukocytes (white blood cell), and urine

Study 1:

- Randomized, double-blind place-controlled trial
- Participants: hospital patients with a mean age of 81 years admitted with acute bronchitis or pneumonia
- Patients' mean plasma vitamin C level was 23 µmol/L
- Experimental group: 0.2 g/day of vitamin C on top of regular treatment
- Control group: treatment without vitamin C
- Vitamin C was found to decrease the respiratory symptom score in the more severely ill patients
 - Less ill counterparts showed no effects
- Five deaths in the control group and only one in the vitamin C group

Study 2:

- Participants: pneumonia patients
- Control group: not given vitamin C
- Low-dose group: ranged from 0.25 to 0.8 g/day
- High-dose group: between 0.5 and 1.6 g/day
- Control group's hospitalization duration was 23.7 days
- Low-dose vitamin C group had a 19% shorter stay
- High-dose group had a 26% shorter stay
- Vitamin C groups reported more normal chest X-rays and temperatures

Vitamin C on COVID-19

- Clinical trials of IVC and COVID-19 are being held in China (The Second Affiliated Hospital of Xi'an Jiaotong University, 2020)
- Clinical trials of IVC and COVID-19 are being held in New York City hospitals (Mongelli & Golding, 2020)

Vitamin C on ICU Duration

Study: (Hemila & Chalker, 2019)

- Meta-analysis: 18 controlled trials with 2,004 patients
- In 12 trials with a total of 1,766 patients, vitamin C decreased ICU stay by 7.8%
- In 6 trials, where vitamin C was taken orally in doses of one to three grams per day, the ICU stay was reduced by 8.6%
- 3 trials that involved patient mechanical ventilation for more than 24 hours, vitamin C reduced time on a mechanical ventilator by 18.2%

Risks of High-Dose Vitamin C

Kidney Stones

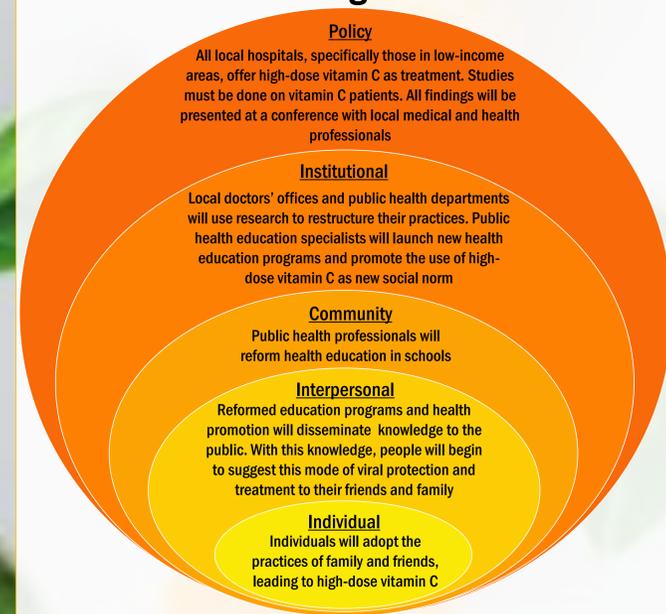
Findings are inconclusive:

- Observational study of 1,387 men: higher vitamin C intake lead to lower levels of serum uric acid levels (Prier et al., 2018)
- Meta-analysis of 13 randomized control trials of healthy individuals with high levels of uric acid: levels decreased after 30 days of 500 mg/day doses (Oregon State University, 2020)
- Prospective case series of 157 patients on IVC: stable renal function
- Nurses' Health Study I and II of 156,735 women and Health Professionals Follow-Up Study of 40,536 men:
 - Total vitamin C intake not significantly associated with kidney stone risk in women, but was in men with intake between 500-999 mg/day
 - Supplemental vitamin C intake was not significantly associated with kidney stone risk in women, but was in men

High-Dose Vitamin C as a Public Health Issue

- Vitamin C is a natural, low-cost, and safe way to boost immunity
- Vitamin C deficiency being the fourth leading vitamin deficiency in the U.S.
- High risk population: people with low socioeconomic status (SES)
 - U.S. children from lower social classes are more absent from school due to upper respiratory infections and ear infections than higher SES counterparts
 - Lower levels of education and higher levels of unemployment associated with higher incidence of acute lower respiratory tract infections
 - Children up to 17-years-old from families receiving federal assistance are more likely to die of pneumonia and influenza (Cohen, 1999)
- Hospitalizations are higher in low SES communities during flu season
- Flu hospitalization data the 2010-2011 and 2011-2012 flu epidemic found flu-related hospitalization incidence in higher poverty census tracts was 21.5, about twice the incidence in lower poverty census tracts (Hadler et al., 2016)

Social Ecological Model



Public Health Recommendations

1. Mandated vitamin C protocols in hospitals. These policies should be:

- Used mostly regarding patients with respiratory illnesses and in ICUs
- Mandatory in low SES areas, due to higher rates of infection and hospitalizations (Cohen 1999; Hadler et al., 2016)

2. Increased funding for research on high-dose vitamin C

- Need more research to squander doubt in medical community

3. Outreach programs consisting of medical staff and public health professionals

- Especially in low SES areas where people may not have the ability to protect themselves with healthy lifestyles and healthcare
- Could increase herd immunity



(Citrus fruits, n.d.)

Conclusion

High-dose vitamin C is a promising avenue for disease prevention and treatment. Vitamin C is:

- Accessible: low-cost, available supplement found in pharmacies and supermarkets
 - A safe way to naturally boost immunity
- Promoting use of high-dose supplemental vitamin C in hospitals could:
- Increase the number of Americans with strong immune systems
 - Decrease hospitalizations
 - Shorten ICU duration
 - Protect Americans from future epidemics by:
 - Preventing hospitals from being overwhelmed
 - Lessening the amount of infected people

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