Vitamin C

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Requirements

Life Stage	Age	Males (mg/d)	Females (mg/d)
Infants	0-6 months	40 (AI)	40 (AI)
Infants	7-12 months	50 (AI)	50 (AI)
Children	1-3 years	15	15
Children	4-8 years	25	25
Children	9-13 years	45	45
Adolescents	14-18 years	75	65
Adults	19 years +	90	75
Smokers	19 years +	125	110
Pregnancy	18 years and younger	-	80
Pregnancy	19 years +	-	85
Breast-feeding	18 years and younger	-	115
Breast-feeding	19 years +	-	120

Institute of Medicine. Panel on Dietary Antioxidants and Related Compounds 2000

Requirements

- RDA Establishment
  - Set by the Institute of Medicine in 2000
  - Food and Nutrition Board's Standing Committee on the Scientific Evaluation of Dietary Reference Intakes was appointed in 1995 to oversee the revision of the RDAs
  -

Institute of Medicine. Panel on Dietary Antioxidants and Related Compounds 2000

Requirements

- Differences in RDAs/DRIs across the life cycle
  - Unlike many other mammals, humans are not able to synthesize vitamin C internally and must get it from the diet
  - Smokers require more Vitamin C due to increased oxidative stress in the body
  - Pregnant and breastfeeding women also require more Vitamin C

Food Sources

Food Sources	Vitamin C Content
1 cup strawberries	90 mg
1 medium kiwi	75 mg
1 medium orange	70 mg
1 cup cantaloupe	68 mg
1 cup pineapple	24 mg
1 banana	12 mg
1/2 cup red pepper	95 mg
1/2 cup Brussels sprouts	48 mg
1/2 cup broccoli	39 mg

Supplement Sources

Supplement Facts

Serving Size: One tablet

	Amount Per Serving	% Daily Value
Vitamin A (20% as beta-carotene)	2500 IU	50%
Vitamin C	60 mg	100%
Vitamin D (as Vitamin D_3)	1000 IU	250%
Vitamin E	22.5 IU	75%
Vitamin K	25 mcg	31%
Thiamin (B_1)	1.5 mg	100%
Riboflavin (B_2)	1.7 mg	100%
Niacin	20 mg	100%
Vitamin B_6	2 mg	100%
Folic Acid	400 mcg	100%
Vitamin B_{12}	6 mcg	100%
Biotin	300 mcg	100%
Pantothenic Acid	10 mg	100%
Calcium (elemental)	500 mg	50%
Iron	18 mg	100%
Iodine	150 mcg	100%
Zinc	15 mg	100%
Selenium	20 mcg	29%
Copper	2 mg	100%
Manganese	2 mg	100%
Chromium	120 mcg	100%

- Easily obtained from diet
  - Natural and synthetic ascorbic acid are chemically identical and have equivalent bioavailability
- Supplementation above 2000 mg/day UL can cause gastrointestinal discomfort
  - No other scientific evidence of severe negative health effects

Deficiency

- Reports of deficiency centuries ago
  - Scurvy
    - subcutaneous bleeding, poor wound closure, bruising easily, hair and tooth loss, and joint pain and swelling.
    - Decreased collagen production leading to weakening of blood vessels, connective tissue, and bone
  - Found that could prevent by eating lemons and oranges
- Deficiency less likely in developed countries
  - Easily obtained from diet
  - Scurvy can be treated with 10 mg/day vitamin C
- Some case reports have been seen in U.S. with alcoholics and children on very restricted diets
  - Reversed with Vitamin C supplementation
    - 100-500 mg PO ascorbic acid TID for 1-2 weeks until signs disappear

http://www.merckmanuals.com/professional/nutritional-disorders/vitamin-deficiency-dependency-and-toxicity/vitamin-c

Toxicity

- UL established to prevent adverse gastrointestinal symptoms
- Serum levels reach a certain saturation, then excess is excreted in the urine
- Increased risk of kidney stones
  - Metabolite of Vitamin C is oxalate
    - Possibly increase calcium oxalate kidney stones
  - Conflicting evidence
    - Some studies have shown increased risk of kidney stones with ≥1000 mg/day Vitamin C in men
    - Others found no increased risk with ≥1500 mg/day Vitamin C
  - If predisposed to kidney stones, consider avoiding high dose Vitamin C supplementation

Tolerable Upper Intake Level of Vitamin C	
Age Group	**UL (mg/day)**
Infants 0-12 months	Not possible to establish*
Children 1-3 years	400
Children 4-8 years	650
Children 9-13 years	1,200
Adolescents 14-18 years	1,800
Adults 19 years and older	2,000
*Source of intake should be from foods or formula only.	

http://lpi.oregonstate.edu/mic/vitamins/vitamin-C#reference17; Curhan GC. J Urol. 1996; Curhan GC. J Am Soc Nephrol. 1999; Taylor EN. J Am Soc Nephrol. 2004; Thomas LD. JAMA Intern Med. 2013.

Unsubstantiated Claims

i. Faulty reasoning behind claim

ii. Explanation of how this relates to metabolism

- Diabetes Prevention
- Common Cold

Vitamin C and Lowering of LDL-C and Triglycerides

Purpose: Meta analysis of RCTs to determine the effect of Vitamin C supplementation on serum LDL-C, HDL-C and triglycerides in patients with hypercholesterolemia

Methods: 13 RCTs between 1970 and June 2007 were used where a total of 14 groups of subjects with hypercholesterolemia were supplemented with at least 500 mg/day Vitamin C between 3 and 24 weeks

Results: Significant reductions in serum LDL-C and triglycerides were seen in subjects supplemented with at least 500 mg/day Vitamin C for at least 4 weeks (−7.9 mg/dL (95% confidence interval [CI], -12.3 to -3.5;p=.000 and -20.1 mg/dL (95% CI, -33.3 to -6.8; $p<0.003$ respectively). No significant changes in HDL-C were seen.

McRae MP. J Chiropr Med. 2008.

Vitamin C and Cancer Treatment

Purpose: Examine possible effects on cancer events post trial follow-up in the Physicians Health Study II

Methods: Beginning in 1997 14,641 US male physicians ≥50 years of age were randomly assigned to either receive 400 IUs Vitamin E every other day, 500 mg of Vitamin C daily or a placebo.

Results: Found no significant difference in overall cancer incidence or incidence of specific sites of cancer (prostate, colorectal, lung, bladder, pancreatic, lymphoma, leukemia, and melanoma) between groups

Limitations: Serum vitamin levels were not measured nor were any inflammatory markers. The subjects were also described as well nourished individuals

Wang, L et al. Am J Clin Nutr. 2014

Research-Jess

Multiple Choice Questions

1. What does a Vitamin C deficiency lead to?

a. Rickets
b. Scurvy
c. BeriBeri
d. Pellagra

2. What patient population requires higher Vitamin C intakes?

a. Infants
b. Cancer patients
c. Smokers
d. Adolescents

3. In terms of the common cold, Vitamin C has been seen to

a. Reduce the duration of a cold
b. Treat cold symptoms
c. Reduce the incidence of a cold in the general population
d. Reduce the incidence of a cold in subjects in a high physical stress
e. Both A and D

References