

Revisiting Vitamin C and Wound Healing

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When discussing nutritional interventions for wound healing with healthcare practitioners, one of the most frequent questions posed is whether specific vitamin and mineral supplements enhance the rate of healing. Vitamin C is always specifically mentioned because it has routinely been prescribed for patients with wounds. As medicine evolves to evidenced-based practice, questions about the efficacy of this standing order have arisen. Currently, practice is divided; some medical facilities continue to supplement vitamin C, while others do not. Rigorously controlled studies concerning vitamin C still are lacking, so the debate and misinformation proliferate. This close look at vitamin C was originally published in *OWM* in 2009, but the need to shed some light on this topic persists.

Why is Vitamin C Associated with Wound Healing?

Vitamin C has many physiologic functions in the human body. It often is aligned with wound healing because of its role in collagen formation. Vitamin C is a co-factor in proline and lysine hydroxylation, a necessary step in the formation of collagen. Hydroxyproline and hydroxylysine are essential for stabilizing the triple helix structure of collagen with strong hydrogen bonds and crosslinks. Without this stabilization, the structure disintegrates rapidly.¹ Vitamin C also provides tensile strength to newly built collagen; otherwise, new tissue could not stretch without tearing. Tensile strength is important in pressure ulcer healing because healed pressure ulcers are susceptible to future skin breakdown. Vitamin C also is required for proper immune system function, a consideration in patients with open wounds.

Other chief functions of vitamin C include:

- As an antioxidant, vitamin C inhibits damage to body cells
- It is an anti-inflammatory
- It is necessary for the synthesis of carnitine, a molecule essential for the transport of fat to mitochondria
- It plays a role in the synthesis of the neurotransmitter norepinephrine
- It protects iron in the intestines from oxidation and promotes absorption
- It protects vitamin E in the blood from oxidation and may recycle it to its active form.

What are the Daily Requirements for Vitamin C?

The dietary reference intakes (DRI) for nutrients are determined by the National Academy of Sciences, Institute of

Table 1. Dietary reference intakes for Vitamin C²

Age group	Recommended dietary allowance (mg)	Upper limit (mg)
0–0.5 year	40	Not determined
0.5–1 year	50	Not determined
1–3 years	15	400
4–8 years	25	650
9–13 years	45	1,200
Female 14–18 years	65	1,800
Female 19–70 years	75	2,000
Male 14–18 years	75	1,800
Male 19–70 years	90	2,000
Pregnant	85	2,000
Lactating	120	2,000

Medicine, Food and Nutrition Board. Each DRI includes a recommended dietary allowance (RDA) and an upper limit (UL). The RDA may be used as a goal for individual intake. RDAs are set to meet the needs of almost all individuals (97% to 98%) in a group.² It is important to note that the RDAs are based on healthy people. The UL represents the maximum daily intake likely to pose no risk of adverse effects. For vitamin C, the RDA for most women and men per day is 70 mg and 90 mg, respectively. The complete DRI for vitamin C is shown in Table 1.

What Happens When Intake of Vitamin C is Deficient?

The deficiency state of vitamin C is called scurvy. The clinical manifestations of scurvy are diverse and affect many of the body's systems. Symptoms range from systemic conditions such as fatigue, weakness, and malaise to red, swollen gums and fragile, easily ruptured capillaries.³

What Foods Contain Vitamin C?

Most people recognize citrus fruits, such as oranges and grapefruits, as good sources of vitamin C. Many other sources provide more than 20% of the RDA in a typical serving, including guava, kiwi, red sweet pepper, strawberries, papaya, broccoli, green pepper, vegetable juice cocktail,

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kohlrabi, Brussels sprouts, cantaloupe, pineapple, kale, edible pea pods, sweet potato, and mango.

It is important to recognize that vitamin C is a water-soluble vitamin. These vitamins are not stored in the body and must be replenished daily. Vitamin C is the most unstable of all water-soluble vitamins; cooking, handling, and processing affects its content in food. The vitamin is easily destroyed by oxygen, alkalis, and high temperature; it also reacts with the metallic ions of iron and copper. Patients should be encouraged to consume at least one daily serving of a vitamin C-rich food.

Should Patients with Pressure Ulcers Be Given Routine Vitamin C Supplementation?

The answer to the question of vitamin C supplementation elicits many different opinions and practices. When looking strictly at the evidence from well-designed studies, information is scant to support the theory that vitamin C supplementation above the RDA improves wound healing. An often-cited study⁴ divided 88 patients into two randomized groups: the first group received ascorbic acid supplementation of 500 mg twice per day while the control group received 10 mg twice per day. Using closure rate as the outcome measurement, the study concluded that ascorbic acid did not speed up wound healing. According to most of the agencies and groups that publish practice guidelines, supplementation is not necessary unless a deficiency is suspected. That said, many facilities and protocols continue to call for routine supplementation.

Why Do Facilities Provide Supplements if Evidence Supporting Supplementation of Vitamin C is Lacking?

Likely, numerous reasons explain why vitamin C supplements are prescribed for pressure ulcers despite the lack of evidence from rigorously controlled studies. First, many patients with pressure ulcers do not consume proper diets and many are under metabolic stress. Because the human body excretes an increased amount of vitamin C when stressed, a deficit actually may exist in many patients. Second, vitamin C is safe and

relatively inexpensive. Third, at typical supplementation levels of 500 mg twice daily (below the tolerable upper limit of 2,000 mg per day set out in the DRI), adverse effects are unlikely. If any adverse effects occurred, they could be reversed simply by stopping the supplement. Fourth, vitamin C is water-soluble — excess is excreted in the urine. Fifth, although the evidence for use in pressure ulcer patients may be lacking, vitamin C provides many other benefits, particularly in the area of immune function. Finally, many facilities have been involved in litigation involving patients with pressure ulcers and often, the expectation is that anything the might possibly be helpful is attempted, providing it does no harm. Caution should be exercised when prescribing for patients who are prone to form kidney stones and those who have iron overload.

What are the Practice Points?

1. Encourage proper meal intake daily, including foods high in vitamin C content.
2. Vitamin C is water-soluble and must be replenished daily.
3. Monitor for the signs of vitamin C deficiency (eg, bleeding gums, bruised skin with many pinpoint hemorrhages, or skin that has become rough, brown, and blotchy with bruises).
4. If vitamin C deficiency is suspected, provide supplements.
5. Consult with a registered dietitian for a complete nutritional assessment and recommendations. ■

References

1. Williams SR. *Nutrition and Diet Therapy*, 8th ed. St Louis, MO: Mosby-Year Book, Inc;1997:197.
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3. Shai A, Maibach HI. *Wound Healing and Ulcers of the Skin*. Heidelberg, Germany: Springer Verlag;2005:230.
4. ter Riet G, Kessels AG, Knipschild PG. Randomized clinical trial of ascorbic acid in the treatment of pressure ulcers. *J Clin Epidemiol*. 1995;48(12):1453–1460.

Clarification Regarding Cochrane Review Quoted Reference

Derma Sciences, Inc (Princeton, NJ) has notified HMP Communications, LLC (HMP) that a quoted reference in a recent advertisement in one of our wound care journal was revised. The original quotation from the 2013 Cochrane Review on honey-based dressings read: “There is insufficient evidence to guide clinical practice in other **types of wounds and purchasers should refrain from providing honey dressings for routine use** until sufficient evidence of effect is available.”

At the request of Derma Sciences, and also to follow the Cochrane Review’s policy of avoiding the offering of advice, this statement was revised on June 19, 2013 to read as follows: “There is insufficient evidence to guide clinical practice in other areas; health services may wish to consider avoiding routine use of honey dressings until sufficient evidence of effect is available.”

HMP apologizes for any confusion and wishes to ensure that our readers have the most recent update to this reference.