

## Update Exclusive

August 1, 2008

## Higher plasma vitamin C levels linked with lower diabetes risk



In the July 28, 2008 issue of the American Medical Association journal *Archives of Internal Medicine*, researchers at Addenbrooke's Hospital and the University of Cambridge in England report an association between higher plasma vitamin C levels in middle-aged adults and a lower risk of developing type 2 diabetes.

The study included 21,831 healthy, nondiabetic participants in the European Prospective Investigation of Cancer-Norfolk study, which was created to examine the association between diet and cancer. Vitamin C levels were measured in plasma, and food frequency questionnaires were administered upon enrollment between 1993 and 1997. Over a twelve year follow-up period, 423 men and 312 women developed diabetes.

Analysis of the data revealed a strong protective effect of high vitamin C levels against diabetes. Participants in the top 20 percent of plasma vitamin C had a 62 percent lower adjusted risk of developing diabetes compared with those in the lowest fifth. Fruit and vegetable intake also emerged as protective. Those whose intake was in the top fifth had a 22 percent lower diabetes risk than subjects whose intake was lowest.

To the authors' knowledge, the study is the first to examine the association of plasma vitamin C and the development of diabetes. The findings suggest that suboptimal levels of vitamin C are present before the onset of the disease.

Increased oxidative stress, defined as an imbalance between reactive oxygen species levels and antioxidants, can result in glucose metabolism disturbances and elevated blood sugar. The authors write that the abundant phytochemicals, minerals and vitamins, including vitamin C, in fruit and vegetables have antioxidant properties that may be responsible for the protective effect against diabetes observed in the current study. Additionally, individuals whose fruit and vegetable intake is greater tend to have lower levels of obesity, which is a strong risk factor for diabetes as well as a promoter of oxidative stress.

"The strong independent association observed in this prospective study, together with biological plausibility, provides persuasive evidence of a beneficial effect of vitamin C and fruit and vegetable intake on diabetes risk," the authors conclude. "Because fruit and vegetables are the main sources of vitamin C, the findings suggest that eating even a small quantity of fruit and vegetables may be beneficial and that the protection against diabetes increases progressively with the quantity of fruit and vegetables consumed."

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## Health Concern

## Diabetes

Several preclinical studies evaluated vitamin C's role during mild oxidative stress. The aqueous humor of the eye provides surrounding tissues with a source of vitamin C. Since animal studies have shown that glucose inhibits vitamin C uptake, this protective mechanism may be impaired in diabetes (Corti A et al 2004).

Supplementation with antioxidant vitamins C and E plays an important role in improving eye health (Peponis V et al 2004). High vitamin C intake depresses glycation, which has important implications for slowing diabetes progression and aging (Krone CA et al 2004).

Vitamin C, through its relationship to sorbitol, also helps prevent ocular complications in diabetes. Sorbitol, a sugar-like

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substance that tends to accumulate in the cells of people with diabetes, tends to reduce the antioxidant capacity of the eye, with a number of possible complications. Vitamin C appears to help reduce sorbitol buildup (Will JC et al 1996).

Vitamin C also has a role in reducing the risk of other diabetic complications. In one clinical study, vitamin C significantly increased blood flow and decreased inflammation in patients with both diabetes and coronary artery disease (Antoniades C et al 2004). Three studies suggest that vitamin C, along with a combination of vitamins and minerals (Farvid MS et al 2004), reduces blood pressure in people with diabetes (Mullan BA et al 2002) and increases blood vessel elasticity and blood flow (Mullan BA et al 2004).

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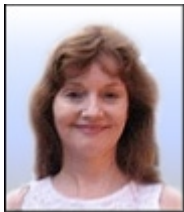
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