

1. Annu Rev Nutr. 2003;23:171-201. Epub 2003 Feb 27.

**Biologic mechanisms of the protective role of lutein and zeaxanthin in the eye.**

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The macular region of the primate retina is yellow in color due to the presence of the macular pigment, composed of two dietary xanthophylls, lutein and zeaxanthin, and another xanthophyll, meso-zeaxanthin. The latter is presumably formed from either lutein or zeaxanthin in the retina. By absorbing blue-light, the macular pigment protects the underlying photoreceptor cell layer from light damage, possibly initiated by the formation of reactive oxygen species during a photosensitized reaction. There is ample epidemiological evidence that the amount of macular pigment is inversely associated with the incidence of age-related macular degeneration, an irreversible process that is the major cause of blindness in the elderly. The macular pigment can be increased in primates by either increasing the intake of foods that are rich in lutein and zeaxanthin, such as dark-green leafy vegetables, or by supplementation with lutein or zeaxanthin. Although increasing the intake of lutein or zeaxanthin might prove to be protective against the development of age-related macular degeneration, a causative relationship has yet to be experimentally demonstrated.

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2. Acta Ophthalmol Scand. 2002 Aug;80(4):368-71.

**Neovascular age-related macular degeneration and its relationship to antioxidant intake.**

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**PURPOSE:** Experimental and epidemiological studies suggest that low antioxidant intake may be associated with the occurrence of neovascular age-related macular degeneration (AMD). **METHODS:** We investigated this hypothesis further with a case-control study involving 72 case and 66 control patients attending the Ophthalmology Department of the University Hospital in Nijmegen. Data were collected by interview on antioxidant intake (i.e. in fruit and vegetables), cigarette smoking, sunlight exposure and familial predisposition. Antioxidant intake was calculated according to the method described in the Framingham Eye Study. Logistic regression analysis was used to estimate odds ratios (OR) and 95% confidence intervals (CI). **RESULTS:** The prevalence rate of AMD in patients with low antioxidant intake and low lutein intake (dichotomized at the median value) was about twice as high as that in patients with high intake: OR = 1.7, 95% CI (0.8-3.7), and OR = 2.4, 95% CI (1.1-5.1). Further specification of intake data into quartiles of antioxidant intake and lutein/zeaxanthine intake showed a clear dose-response relationship. **CONCLUSION:** The effect of dietary antioxidants upon macular health warrants preventive studies.

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3. JAMA. 1994 Nov 9;272(18):1413-20.

**Dietary carotenoids, vitamins A, C, and E, and advanced age-related macular degeneration. Eye Disease Case-Control Study Group.**

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**OBJECTIVE**--To evaluate the relationships between dietary intake of carotenoids and vitamins A, C, and E and the risk of neovascular age-related macular degeneration (AMD), the leading cause of irreversible blindness among adults. **DESIGN**--The multicenter Eye Disease Case-Control Study. **SETTING**--Five ophthalmology centers in the United States. **PATIENTS**--A total of 356 case subjects who were diagnosed with the advanced stage of AMD within 1 year prior to their enrollment, aged 55 to 80 years, and residing near a participating clinical center. The 520 control subjects were from the same geographic areas as case subjects, had other ocular diseases, and were frequency-matched to cases according to age and sex. **MAIN OUTCOME MEASURES**--The relative risk for AMD was estimated according to dietary indicators of antioxidant status, controlling for smoking and other risk factors, by using multiple logistic-regression analyses.

**RESULTS**--A higher dietary intake of carotenoids was associated with a lower risk for AMD. Adjusting for other risk factors for AMD, we found that those in the highest quintile of carotenoid intake had a 43% lower risk for AMD compared with those in the lowest quintile (odds ratio, 0.57; 95% confidence interval, 0.35 to 0.92; P for trend = .02). Among the specific carotenoids, lutein and zeaxanthin, which are primarily obtained from dark green, leafy vegetables, were most strongly associated with a reduced risk for AMD (P for trend = .001). Several food items rich in carotenoids were inversely associated with AMD. In particular, a higher frequency of intake of spinach or collard greens was associated with a substantially lower risk for AMD (P for trend < .001). The intake of preformed vitamin A (retinol) was not appreciably related to AMD. Neither vitamin E nor total vitamin C consumption was associated with a statistically significant reduced risk for AMD, although a possibly lower risk for AMD was suggested among those with higher intake of vitamin C, particularly from foods. **CONCLUSION**--Increasing the consumption of foods rich in certain carotenoids, in particular dark green, leafy vegetables, may decrease the risk of developing advanced or exudative AMD, the most visually disabling form of macular degeneration among older people. These findings support the need for further studies of this relationship.

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