

Review: Evidence links Higher Macular Pigment Density with Lutein

The authors provide an overview of the literature related to the role of lutein in eye, skin and cardiovascular health. A summary of published human intervention studies investigating the direct effects of dietary or supplemental lutein on macular pigment density is presented. In general, these studies demonstrate that macular pigment density can be favorably impacted by lutein intakes ranging from 10-30 mg over the short term.

Alves-Rodrigues A and Shao A. Review. The Science Behind Lutein. *Toxicology Letters* 150:57-83, 2004.

AREDS Analysis: Higher Lutein Intake Linked to AMD Risk Reduction

Higher dietary intake of lutein and zeaxanthin was independently associated with a reduced likelihood of having neovascular AMD, geographic atrophy, and large or extensive intermediate drusen. No other nutrients were independently related to AMD in this analysis of AREDS participants. Subjects consuming the highest amount of lutein and zeaxanthin were 35% less likely to have neovascular AMD and 55% less likely to have geographic atrophy than those eating the least. Those whose diets provided the most of these two carotenoids also had a 26% reduced likelihood of having large or extensive drusen.

AREDS Report No. 22: The relationship of dietary carotenoids with age-related macular degeneration in a case-control study. *Archives Ophthalmology* 125:1225-32, 2007.

Lutein Supplements Restore Macular Pigment Density in AMD

This NEI-sponsored study found that macular levels of carotenoids decline with age. AMD patients who did not use lutein supplements had even lower macular carotenoid content than healthy older eyes—about 32% lower. In contrast, AMD patients taking high dose

supplemental lutein had macular carotenoid content similar to people their age without the disease.

Bernstein PS, et al. Resonance Raman measurement of macular carotenoids in normal subjects and in age-related macular degeneration patients. *Ophthalmology* 109: 1780-87, 2002.

Serum Levels of Lutein Correlate with Macular Pigment Density

The relation between macular pigment density (MPD) and lutein intake and serum levels was examined in healthy volunteers. The analysis revealed that both the concentration of lutein in serum and lutein intake significantly correlate with MPD in a positive manner: the higher the level in serum or in the diet, the higher the MPD.

Curran-Celentano J et al. Relation between dietary intake, serum concentrations, and retinal concentrations of lutein and zeaxanthin in adults in a Midwest population. *American Journal of Clinical Nutrition* 74:79-802, 2001.

Serum Lutein Levels Linked to Less Carotid Artery Narrowing

The findings from this study suggest a potential role for lutein and other oxygenated carotenoids in protecting against atherosclerosis in middle-aged participants free of CVD symptoms. Those with the highest blood levels of lutein, as well as zeaxanthin, beta-cyptoxanthin and alpha carotene, were found to have significantly less progression in carotid artery plaque build-up over a 1 1/2 year period, compared to those with lower blood concentrations. Earlier studies suggest that lutein may act by modifying inflammation, part of the process that leads to plaque formation and artery narrowing.

Dwyer JH et al. Progression of carotid intima-media thickness and plasma antioxidants: the Los Angeles Atherosclerosis Study. *Arteriosclerosis Thrombosis Vascular Biology* 24:313-9, 2004.

DHA May Lower AMD Risk via Increased Lutein Transport in Macula

The main objective of this controlled, 4-month study was to determine the effects of lutein (12 mg/d), DHA (800 mg/d), lutein plus DHA, or placebo on macular pigment optical density (MPOD) and lipoprotein fractions in women (60-80 yrs). Researchers report that lutein increased MPOD eccentrically, DHA resulted in central increases, and lutein + DHA had a combined effect on the MPOD spatial profile. These results may be due to changes in lipoprotein sub-fractions, which were greatest for the lutein + DHA group. DHA may decrease risk of AMD by increasing transport of lutein into the macula.

Johnson EJ et al. The influence of supplemental lutein and docosa-hexaenoic acid on serum, lipoproteins, and macular pigmentation. *American Journal Clinical Nutrition* 87:1521-9, 2008.

Supplemental Lutein Increases MPOD in Early AMD

Investigators evaluated the effects of supplemental lutein (equivalent to 10 mg "free lutein") in a small number of patients with early stages of AMD and age-matched controls. The findings provide preliminary evidence that not only those with healthy eyes can accumulate lutein in the macula, but those with early stage AMD can as well.

Koh HH et al. Plasma and macular responses to lutein supplement in subjects with and without age-related maculopathy: a pilot study. *Experimental Eye Research* 79:21-27, 2004.

Stable Intake of Lutein and Zeaxanthin Reduces AMD Risk in Women

The Carotenoids in Age-related Eye Disease Study (CAREDS) is an ancillary study of the Women's Health Initiative. CAREDS was designed, in part, to evaluate the relationship between dietary lutein/zeaxanthin

and the prevalence of intermediate AMD in over 1780 women aged 50-79 who had high or low intake of lutein plus zeaxanthin. The authors report that a stable intake of these carotenoids over time reduced AMD risk by 43% in healthy women under 75.

Moeller SM et al. Age-Related Macular Degeneration and Lutein and Zeaxanthin in the Carotenoids in Age-Related Eye Disease Study (CAREDS). *Archives Ophthalmology* 124:1151-1162, 2006.

Supplemental Lutein Clinically Improves Vision Parameters in AMD

The effects of supplemental lutein (10 mg alone, or combined with other antioxidants) on macular pigment optical density (MPOD) and objective visual outcomes were examined in patients with atrophic AMD in this year-long trial. Both the lutein and antioxidant treatments significantly improved MOPD, glare recovery, quality of vision and near visual acuity.

Richer S et al. Double-masked, placebo-controlled, randomized trial of lutein and antioxidant supplementation in the intervention of atrophic age-related macular degeneration: the Veterans LAST study (Lutein Antioxidant Supplementation Trial). *Optometry* 75:216-30, 2004.

AMD Risk Reduction with Higher Lutein Consumption

Investigators evaluated the relationships between dietary intake of carotenoids, vitamins A, C, and E and the risk of neovascular age-related macular degeneration (AMD). People who consumed the highest amounts of lutein & zeaxanthin, 6-7 mg on average, significantly lowered their risk of developing advanced AMD compared to those consuming the least amounts.

Seddon JM et al. Dietary carotenoids, vitamins A, C and E, and advanced age-related macular degeneration. *Journal American Medical Association* 272:1413-20, 1994.