

OMEGA-3 FATTY ACIDS AND EYE HEALTH

Introduction

The body's highest concentration of DHA (docosahexaenoic acid) omega-3 is found in the retina of the eye at concentrations up to 65%^{1,2} and its presence enhances the development of photoreceptors, specialized cells in the retina necessary for vision.³ High DHA concentrations are needed for rhodopsin, a pigment in the photoreceptor rod cells, to respond to light in a way that permits vision in dim light and at night.⁴ The highly unsaturated nature of DHA has unique effects on retinal cell membranes allowing them to transmit light signals very quickly. DHA's contribution to visual development is so well established that the EU adopted two associated health claims.⁵ Omega-3s are thought to help prevent the development of and/or attenuate the progression of age-related macular degeneration (AMD), as well as help alleviate symptoms of dry eye.

Age-Related Macular Degeneration (AMD)

According to the National Eye Institute of the National Institutes of Health, age-related macular degeneration (AMD) is a common eye condition and a leading cause of vision loss among people age 50 and older.⁶ It causes damage to the macula, a small spot near the center of the retina and the part of the eye needed for sharp, central vision, which lets us see objects that are straight ahead.

There are three stages of AMD that are defined, in part, by the size and number of drusen (yellow deposits under the retina).

- 1) Early AMD: This stage is defined by the presence of medium-sized drusen, which are about the width of an average human hair. People with early AMD typically do not have vision loss.
- 2) Intermediate AMD: This stage is defined by the presence of large drusen, pigment changes in the retina, or both. Intermediate AMD may cause some vision loss, but most people will not experience any symptoms.
- 3) Late AMD: This stage is defined by drusen, in addition to vision loss from damage to the macula (small spot near the center of the retina and the part of the eye needed for sharp, central vision, which lets us see objects that are straight ahead). There are two types of late AMD:
 - a. Dry AMD (aka geographic atrophy)
 - b. Wet AMD (aka neovascular AMD)

Omega-3s and AMD

Data from prospective studies suggesting that higher intakes of n-3 LCPUFAs and fish provide protection against AMD has been consistently positive.⁷⁻¹⁵ In addition, both plasma n-3 LCPUFA and red blood cell EPA+DHA have been shown to be strongly associated with a reduced risk for late AMD.¹⁶⁻¹⁷

The data from intervention trials has been mixed.

- In some trials, daily supplementation with n-3 LCPUFAs (130-280 mg/day) plus one or more of the following: lutein, zeaxanthin, and antioxidants was shown to be effective in increasing the macular pigment optical density,¹⁸⁻²⁰ providing evidence that there is a protective effect

on the macula in individuals with AMD. In an open-label study providing EPA+DHA (5 g/day), improvement in visual acuity occurred in 100% of patients.²¹

- High doses of EPA+DHA (4 g/day) did not have any measurable effect on visual acuity or retinal function.²²
- EPA+DHA (1110 mg/day) provided to patients with choroidal neovascularization (CNV – eye grows new blood vessels because it needs more oxygen) showed no benefit over placebo when all subjects were included in the analysis; however, individuals achieving the highest tertile of EPA+DHA levels in red blood cells had significantly lower risk of CNV developing over three years.²³
- In the largest trial to date, EPA+DHA (1 g/day) did not reduce the risk of progression to advanced AMD (Age-Related Eye Disease Study 2 Research Group).²⁴

Given the inconsistent results, further research is necessary to support increasing intake of EPA+DHA via the diet or supplementation for the explicit purpose of preventing or slowing the progression of AMD. The strongest evidence of a potential benefit appears to be in preventing or reducing the risk of developing AMD, rather than treating it.

Dry Eye

According to the National Eye Institute of the National Institutes of Health, dry eye is a condition that occurs when the eye does not produce tears properly, or when the tears are not of the correct consistency and evaporate too quickly.²⁵ Comparison of results between studies is difficult for a number of reasons. First, dry eye is a multifactorial disease, affecting both tears and the surface of the eye. Second, diagnostic tests (e.g. tear break-up time (TBUT), Schirmer I test, Ocular Surface Disease Index© (OSDI©), meibomian gland expression, etc...) for dry eye are not standardized. Third, some of the tests are poorly associated with subjective symptoms.

Despite these issues, results from the growing body of scientific evidence on the effect(s) of omega-3s on dry eye appear promising, albeit still inconclusive.²⁶⁻²⁹ Results from two upcoming studies should provide additional insight into the benefits, or lack thereof, of omega-3s for dry eye.³⁰⁻³¹ The primary outcome measurement in both studies is OSDI©, an outcome that has been shown previously to be positively affected by omega-3s.³²⁻³³

Finally, of particular interest is a novel class of bioactive lipid mediators, enzymatically biosynthesized from EPA and DHA, termed resolvins and protectins.³⁴⁻³⁵ A resolvin-based eye drop for dry eyes is under clinical development.³⁶

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