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EYE HEALTH SUPPLEMENTS

WHY DIET IS NOT ALWAYS ENOUGH

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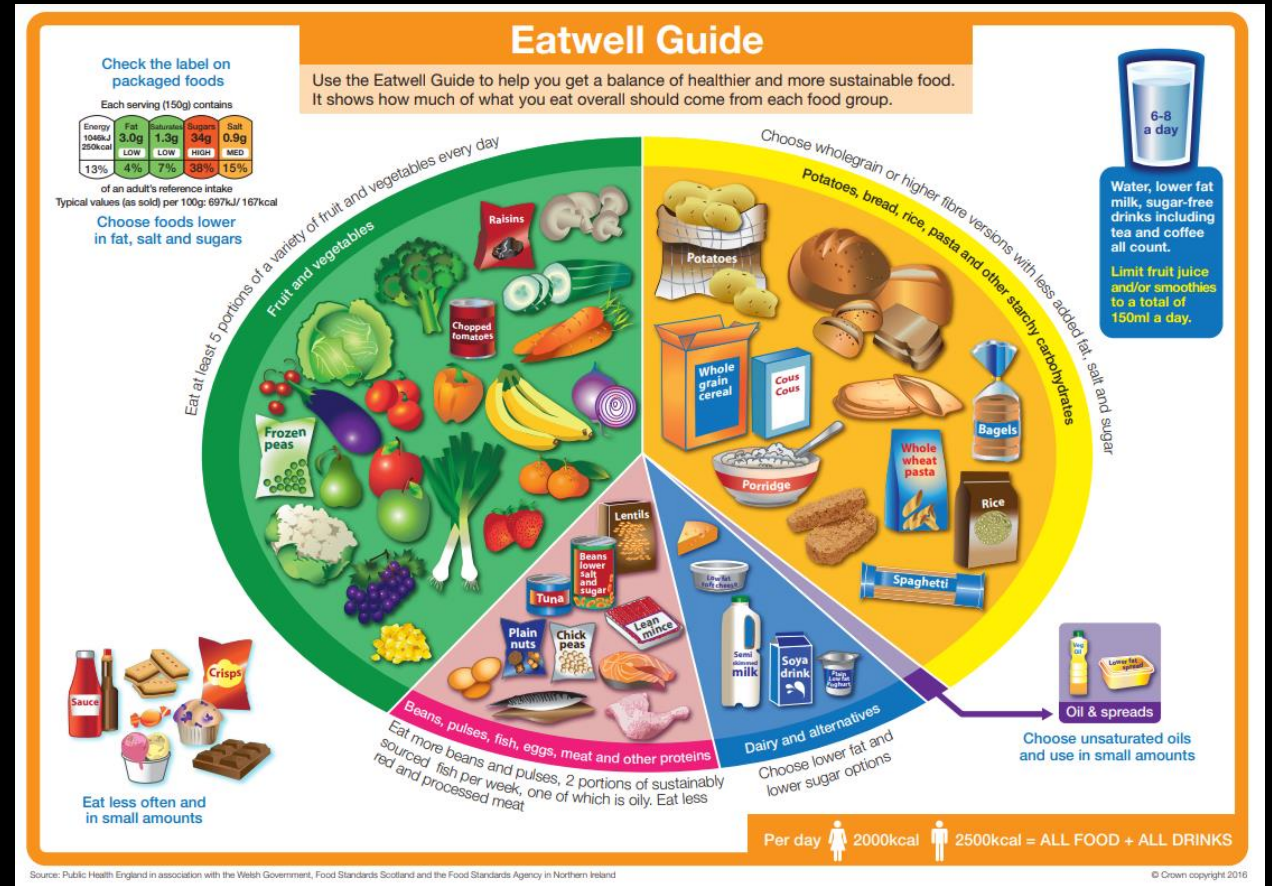


Eatwell Guide:

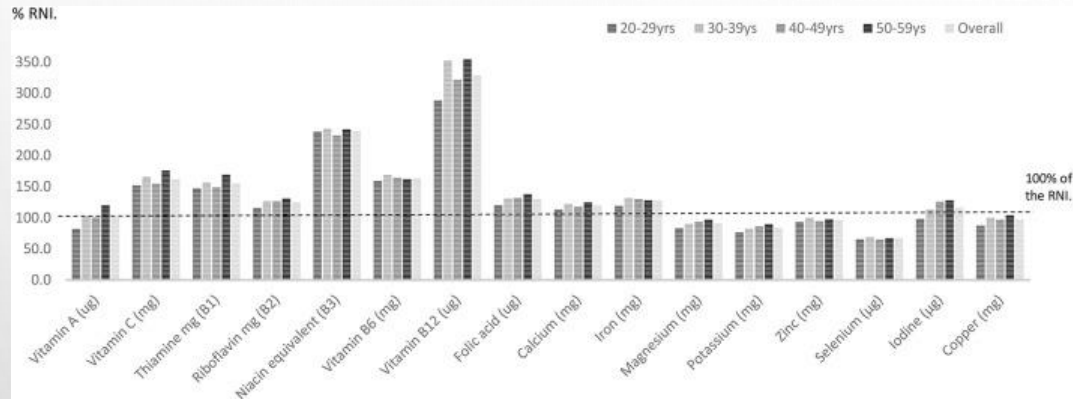
5 Portions of Fruit/Veg per day

Starchy Foods – just over 1/3 of your diet

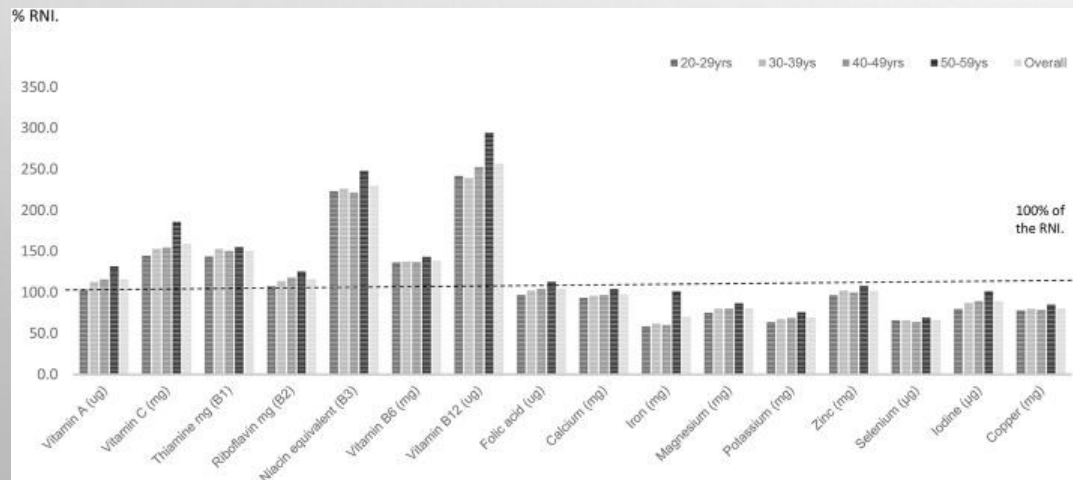
Protein & Dairy



How does the average UK diet perform?



Percentage RNI (Reference Nutrient Intake) for UK males across mid-life.



Percentage RNI for UK females across mid-life.



Derbyshire E. Micronutrient Intakes of British Adults Across Mid-Life: A Secondary Analysis of the UK National Diet and Nutrition Survey. *Front Nutr.* 2018 Jul 19;5:55. doi: 10.3389/fnut.2018.00055. PMID: 30073167; PMCID: PMC6060686.

“UK females and younger adults appear to be particularly vulnerable to micronutrient shortfalls from food sources alone. Clearly, improvements in dietary quality are needed across mid-life. Alongside this, fortification and supplementation strategies may be considered to help adults achieve dietary targets at this life-stage when they should be at their nutritional prime”

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**HOW DOES
THE
AVERAGE UK
DIET
PERFORM?**



Discussion Point:

**What Micro Nutrients Do We
Need For Ocular Health?**



What Micro Nutrients Do We Need For Ocular Health?

Vitamin A

Vitamin A deficiency is one of the most common causes of blindness in the world

Vitamin A is essential for maintaining photoreceptors

Vitamin A deficiency can cause:

- Night blindness
- Conjunctival xerosis
- Bitot's spots
- Corneal xerosis
- Corneal ulcer covering less than 1/3 of the cornea
- Corneal ulcer covering at least 1/3 of the cornea, defined as keratomalacia
- Corneal scarring

DeMaeyer EM. The WHO programme of prevention and control of vitamin A deficiency, xerophthalmia and nutritional blindness. *Nutr Health*. 1986;4(2):105-12. doi: 10.1177/026010608600400206. PMID: 3090484.

Gilbert C. The eye signs of vitamin A deficiency. *Community Eye Health*. 2013;26(84):66-7. PMID: 24782581; PMCID: PMC3936686.



What Micro Nutrients Do We Need For Ocular Health?

Lutein and Zeaxanthin



Lutein & Zeaxanthin are yellow carotenoid antioxidants known as macular pigments concentrated in the Macula

Thought to play a central role in protection against blue light

Studies show that intake of Lutein & Zeaxanthin is proportional to levels found in the retina

Krinsky NI. Possible biologic mechanisms for a protective role of xanthophylls. *J Nutr.* 2002 Mar;132(3):540S-542S. doi: 10.1093/jn/132.3.540S. PMID: 11880589.

Ma L, Liu R, Du JH, Liu T, Wu SS, Liu XH. Lutein, Zeaxanthin and Meso-zeaxanthin Supplementation Associated with Macular Pigment Optical Density. *Nutrients.* 2016 Jul 12;8(7):426. doi: 10.3390/nu8070426. PMID: 27420092; PMCID: PMC4963902.

One study showed that 6mg of Lutein &/or Zeaxanthin per day significantly reduced risk of AMD and those with the highest intake had 43% lower risk compared to those with the lowest intake

Seddon JM, Ajani UA, Sperduto RD, Hiller R, Blair N, Burton TC, Farber MD, Gragoudas ES, Haller J, Miller DT, et al. Dietary carotenoids, vitamins A, C, and E, and advanced age-related macular degeneration. *Eye Disease Case-Control Study Group. JAMA.* 1994 Nov 9;272(18):1413-20. Erratum in: *JAMA* 1995 Feb 22;273(8):622. PMID: 7933422.

Dietary sources that are rich in Lutein and Zeaxanthin



What Micro Nutrients Do We Need For Ocular Health?

Omega 3 – Fatty Acids

Long chain Omega 3 fatty acids EPA & DHA are important for ocular health

DHA is found in the retina, maintaining eye function & is also important for brain & eye function during infancy. DHA deficiency can impair vision in children

Evidence shows that Omega 3 is beneficial to patients with dry eye disease by increasing the formation of the tear film

Innis SM. Dietary omega 3 fatty acids and the developing brain. *Brain Res.* 2008 Oct 27;1237:35-43. doi: 10.1016/j.brainres.2008.08.078. Epub 2008 Sep 9. PMID: 18789910.

Wojtowicz JC, Butovich I, Uchiyama E, Aronowicz J, Agee S, McCulley JP. Pilot, prospective, randomized, double-masked, placebo-controlled clinical trial of an omega-3 supplement for dry eye. *Cornea.* 2011 Mar;30(3):308-14. doi: 10.1097/ICO.0b013e3181f22e03. Erratum in: *Cornea.* 2011 Dec;30(12):1521. PMID: 21045648.



A study in middle-aged and older adults with diabetes found that taking at least 500 mg of long-chain omega-3s daily may reduce the risk of diabetic retinopathy

Sala-Vila A, Díaz-López A, Valls-Pedret C, Cofán M, García-Layana A, Lamuela-Raventós RM, Castañer O, Zanon-Moreno V, Martínez-González MA, Toledo E, Basora J, Salas-Salvadó J, Corella D, Gómez-Gracia E, Fiol M, Estruch R, Lapetra J, Fitó M, Arós F, Serra-Majem L, Pintó X, Ros E; Prevención con Dieta Mediterránea (PREDIMED) Investigators. Dietary Marine ω -3 Fatty Acids and Incident Sight-Threatening Retinopathy in Middle-Aged and Older Individuals With Type 2 Diabetes: Prospective Investigation From the PREDIMED Trial. *JAMA Ophthalmol.* 2016 Oct 1;134(10):1142-1149. doi: 10.1001/jamaophthalmol.2016.2906. PMID: 27541690.



What Micro Nutrients Do We Need For Ocular Health?

Omega 6 – Fatty Acids



Gamma-linolenic acid (GLA) is an omega-6 fatty acid found in small amounts in the modern diet

Unlike many other omega-6 fatty acids, GLA appears to have anti-inflammatory properties

The richest sources of GLA are evening primrose oil and starflower oil. Some evidence suggests that taking evening primrose oil may reduce the symptoms of dry eye disease



Kapoor R, Huang YS. Gamma linolenic acid: an antiinflammatory omega-6 fatty acid. *Curr Pharm Biotechnol.* 2006 Dec;7(6):531-4. doi: 10.2174/138920106779116874. PMID: 17168669.

Kokke KH, Morris JA, Lawrenson JG. Oral omega-6 essential fatty acid treatment in contact lens associated dry eye. *Cont Lens Anterior Eye.* 2008 Jun;31(3):141-6; quiz 170. doi: 10.1016/j.clae.2007.12.001. Epub 2008 Mar 4. PMID: 18313350.

What Micro Nutrients Do We Need For Ocular Health?

Vitamin E

Vitamin E is a group of fat-soluble antioxidants that protect fatty acids from harmful oxidation

The retina has a high concentration of fatty acids, adequate vitamin E intake is important for optimal eye health

Although severe vitamin E deficiency may lead to retinal degeneration and blindness, it's unclear whether supplements provide any additional benefits if you're already getting enough from your diet

SanGiovanni JP, Chew EY. The role of omega-3 long-chain polyunsaturated fatty acids in health and disease of the retina. *Prog Retin Eye Res.* 2005 Jan;24(1):87-138. doi: 10.1016/j.preteyeres.2004.06.002. PMID: 1555528.

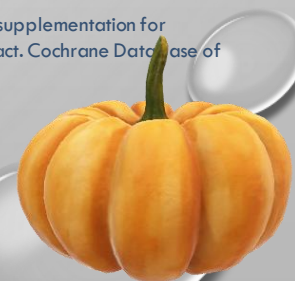
Stoyanovsky DA, Goldman R, Darrow RM, Organisciak DT, Kagan VE. Endogenous ascorbate regenerates vitamin E in the retina directly and in combination with exogenous dihydrolipoic acid. *Curr Eye Res.* 1995 Mar;14(3):181-9. doi: 10.3109/02713689509033513. PMID: 7796601.



One study suggests that consuming more than 7 mg of vitamin E daily may reduce your risk of age-related cataracts by 6%, however, some studies indicate that vitamin E supplements do not slow or prevent the progression of cataracts

Zhang Y, Jiang W, Xie Z, Wu W, Zhang D. Vitamin E and risk of age-related cataract: a meta-analysis. *Public Health Nutr.* 2015 Oct;18(15):2804-14. doi: 10.1017/S1368980014003115. Epub 2015 Jan 16. PMID: 25591715.

Mathew MC, Ervin A-M, Tao J, Davis RM. Antioxidant vitamin supplementation for preventing and slowing the progression of age-related cataract. *Cochrane Database of Systematic Reviews* 2012, Issue 6. Art. No.: CD004567. DOI: 10.1002/14651858.CD004567.pub2



What Micro Nutrients Do We Need For Ocular Health?

Zinc

Eyes contain high levels of Zinc, which is part of many essential enzymes that function as an antioxidant

Zinc appears to be involved in the formation of visual pigments in the retina. For this reason, zinc deficiency may lead to night blindness

Karcioglu ZA. Zinc in the eye. *Surv Ophthalmol.* 1982 Sep-Oct;27(2):114-22. doi: 10.1016/0039-6257(82)90195-3. PMID: 6755784.

Solomons NW, Russell RM. The interaction of vitamin A and zinc: implications for human nutrition. *Am J Clin Nutr.* 1980 Sep;33(9):2031-40. doi: 10.1093/ajcn/33.9.2031. PMID: 6774607.



In one study, older adults with early macular degeneration were given zinc supplements. Their macular deterioration slowed, and they maintained their visual sharpness better than those who received a placebo

Newsome DA, Swartz M, Leone NC, Elston RC, Miller E. Oral zinc in macular degeneration. *Arch Ophthalmol.* 1988 Feb;106(2):192-8. doi: 10.1001/archophth.1988.01060130202026. PMID: 3277606.

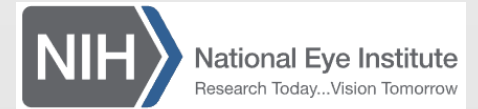
CAN SUPPLEMENTS IMPROVE EYE HEALTH & VISION?

AREDS/AREDS 2 – Age Related Eye Disease Study

The Age-Related Eye Disease Study (AREDS) and AREDS2 are major clinical trials sponsored by the National Eye Institute. The AREDS studies were designed to learn more about the natural history and risk factors of age-related macular degeneration (AMD) and cataract and to evaluate the effect of vitamins on the progression of these eye diseases.

Results from AREDS 2 took what was learned from AREDS and improved the supplement recommendations.

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AREDS/AREDS 2 – Age Related Eye Disease Study

The AREDS 2 Formula:

| Antioxidant | AREDS Dose | AREDS 2 Dose |
|---------------|---|---|
| Vitamin C | 500mg | 500mg |
| Vitamin E | 400IU | 400IU |
| Beta-carotene | 15mg | - |
| Lutein | - | 10mg |
| Zeaxanthin | - | 2mg |
| Zinc | 80mg | 80mg |
| Copper | 2mg (to prevent copper deficiency caused by Zinc) | 2mg (to prevent copper deficiency caused by Zinc) |

A unit used to measure the activity of many vitamins, hormones, enzymes, and drugs. An IU is the amount of a substance that has a certain biological effect. For each substance there is an international agreement on the biological effect that is expected for 1 IU. Also called International Unit.

Discussion Points:

What is your understanding of the AREDS/AREDS 2 studies?

How effective were the formulae?

What considerations should you make when recommending supplements to patients?

How do Lutein & Zeaxanthin compare to Beta-carotene?



AREDS/AREDS 2 – Age Related Eye Disease Study

AREDS vs AREDS 2

In the AREDS trial, taking the AREDS formula reduced the risk of advanced AMD by about 25% over a five-year period.

In the AREDS2 trial, adding omega-3s or lutein + zeaxanthin to the AREDS formulation (containing beta-carotene) had no additional overall effect on the risk of advanced AMD.

However, trial participants who took AREDS containing lutein + zeaxanthin and no beta-carotene had a reduction in risk of advanced AMD, compared with those who took AREDS with beta-carotene.

Also, for participants with very low levels of lutein and zeaxanthin in their diet, adding these supplements to the AREDS formulation helped lower their risk of advanced AMD.

Finally, former smokers who took AREDS with beta-carotene had a higher incidence of lung cancer.

What are lutein, zeaxanthin, and beta-carotene?

Lutein, zeaxanthin, and beta-carotene belong to a family of nutrients known as carotenoids

Carotenoids are made by plants and are enriched in green leafy vegetables

They can be stored in animal tissues and are found at relatively low levels in animal-based foods

In the body, beta-carotene is used to make vitamin A, which is required by the retina to detect light and convert it into electrical signals

Beta-carotene itself is not found in the eye. In contrast, lutein and zeaxanthin are found in the retina and lens, where they may act as natural antioxidants and help absorb damaging, high-energy blue and ultraviolet light

| Top food sources of carotenoids | | | | |
|--|---|--|---|---|
| Astaxanthin |  Algae |  Salmon |  Shrimp |  Trout |
| Beta-carotene |  Carrots |  Mangos |  Pumpkin |  Sweet potatoes |
| Lutein |  Avocados |  Egg yolks |  Spinach |  Basil |
| Lycopene |  Tomatoes |  Papayas |  Watermelons |  Red carrots |
| Zeaxanthin |  Corn |  Eggs |  Orange peppers |  Goji berries |

HOW DO LUTEIN AND ZEAXANTHIN COMPARE TO BETA- CAROTENE?

During the AREDS trial, two large trials funded by the National Cancer Institute found that beta-carotene may increase lung cancer risk among people who smoke

Lutein and zeaxanthin have not been associated with increased cancer risk

Some studies prior to AREDS2 found that dietary intake of lutein, zeaxanthin and omega-3 fatty acids is associated with a lower risk of developing advanced AMD

Analysis from the AREDS2 trial suggests that lutein + zeaxanthin offers similar or better protective benefits against advanced AMD compared with beta-carotene

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HOW DO LUTEIN AND ZEAXANTHIN COMPARE TO BETA-CAROTENE?

In the trial, participants who took an AREDS formulation containing lutein + zeaxanthin lacking beta-carotene had an 18% lower risk of progressing to advanced AMD compared with those who took AREDS containing beta-carotene (no lutein or zeaxanthin)

Among participants who had the lowest dietary intake of lutein and zeaxanthin, those who took AREDS with lutein + zeaxanthin had a 26% lower risk of progressing to advanced AMD compared to participants taking the original AREDS formula.

In the AREDS2 trial, current smokers or those who had quit smoking less than a year before enrolment were excluded from receiving beta-carotene.

Despite this precaution, lung cancers were observed in 2% of participants who took an AREDS formulation with beta-carotene, compared with 0.9% of participants who took AREDS without beta-carotene. Across both groups, about 91% of participants who developed lung cancer were former smokers

AREDS/AREDS 2 – Age Related Eye Disease Study

The AREDS 2 Formula: Important things to remember...

In clinical trials, the AREDS and AREDS2 formulas benefited people with intermediate or late AMD. There was no benefit for people with early AMD or for people who do not have AMD

Nutritional supplements cannot prevent AMD. However, the AREDS/AREDS2 supplements may delay progression of intermediate to advanced AMD and may help maintain vision

The AREDS and AREDS2 formulas do not substitute for multivitamins. In AREDS, two-thirds of the study participants took multivitamins along with the AREDS formulation. In AREDS2, almost nine of ten participants took multivitamins



AREDS/AREDS 2 – Age Related Eye Disease Study

The AREDS 2 Formula: Important things to remember...

AREDS was designed to determine if daily intake of certain vitamins and minerals could reduce the risk of cataract and AMD

There was no effect on cataract

AREDS2 participants with the lowest level of dietary lutein and zeaxanthin, measured at enrolment, who took a formulation including those nutrients had on average a 32% reduction in progression to cataract surgery



Discussion Point:

What is Meso-Zeaxanthin & what role does it play in macula health?



WHAT IS MESO-ZEAXANTHIN?

- THE 3RD CAROTENOID THAT MAKES UP MACULA PIGMENT
- CAROTENOIDS ARE PRESENT IN WILDLY VARYING AMOUNTS THROUGHOUT ALL ORGANISMS IN THE FOOD CHAIN
- RESPONSIBLE FOR BRIGHT COLOURATION IN EVERYTHING FROM BIRD'S PLUMAGE TO BRIGHT COLOURS IN FISH AS WELL AS BEING ESSENTIAL COMPONENTS OF PLANTS PHOTOSYNTHETIC APPARATUS
- IN HUMANS THEY FUNCTION AS THE PIGMENT OF THE MACULA LUTEA, THE YELLOW SPOT AT THE CENTRE OF THE FOVEA
- THIS IS WHERE WE FIND LUTEIN, ZEAXANTHIN AND *MESO-ZEAXANTHIN*

• LUTEIN, ZEAXANTHIN, AND MESO-ZEAXANTHIN: THE BASIC AND CLINICAL SCIENCE UNDERLYING CAROTENOID-BASED NUTRITIONAL INTERVENTIONS AGAINST OCULAR DISEASE PAUL S. BERNSTEIN A, *, 1, BINXING LI A, 1, PREEJITH P. VACHALI A, 1, ARUNA GORUSUPUDI A, 1, RAJALEKSHMY SHYAMA, 1, BRADLEY S. HENRIKSEN A, 1, JOHN M. NOLAN B

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What is Meso-Zeaxanthin?

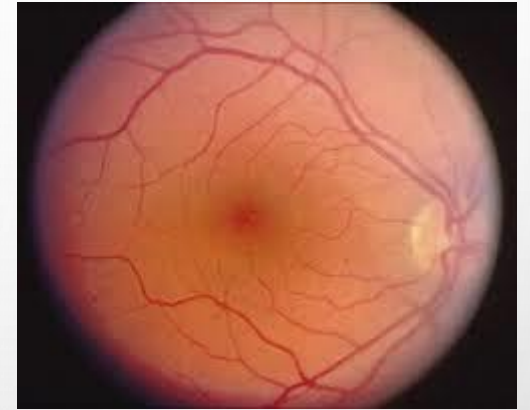
There are around 700 carotenoids found in nature

Only 15-30 enter the human blood stream

Only 2 of those – Lutein & Zeaxanthin – reach the human retina

Meso-Zeaxanthin is not found in diet but is formed at the macula by the metabolic transformations of ingested carotenoids

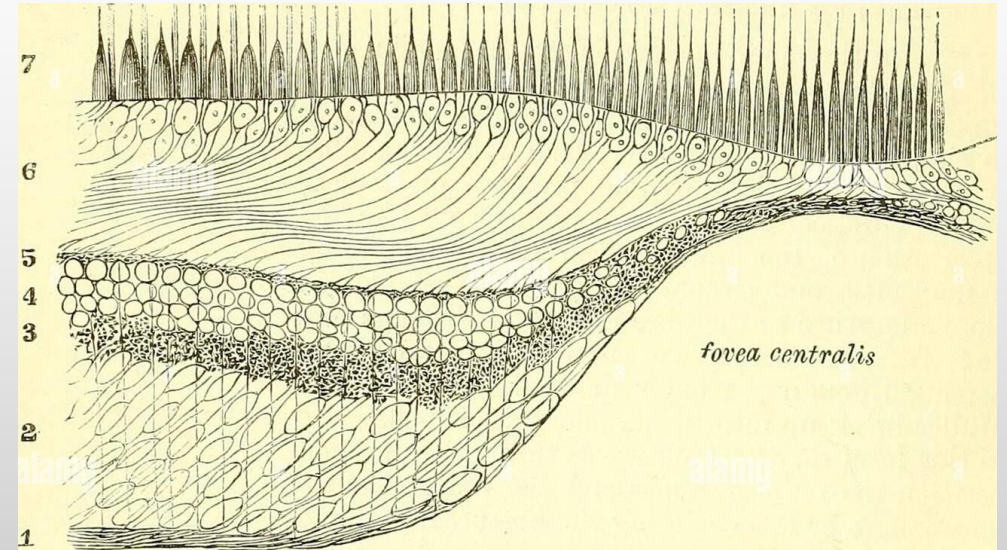
Of the three macular carotenoids in the eye, Meso-Zeaxanthin is the most powerful. Studies show that when Meso-Zeaxanthin combines with Lutein and Zeaxanthin, they become even more effective than they are on their own to help rebuild macular pigment, screen out blue light, fight inflammation & reduce oxidative stress



Lutein, zeaxanthin, and meso-zeaxanthin: The basic and clinical science underlying carotenoid-based nutritional interventions against ocular disease Paul S. Bernstein ^{a, *}, 1, Binxing Li ^{a, 1}, Preejith P. Vachali ^{a, 1}, Aruna Gorusupudi ^{a, 1}, Rajalekshmy Shyam ^{a, 1}, Bradley S. Henriksen ^{a, 1}, John M. Nolan ^b

Lutein is predominantly found in the periphery of the Macula, with Zeaxanthin found in the mid-periphery and Meso-Zeaxanthin found at the epicentre.

Nolan JM, Meagher K, Kashani S, Beatty S. What is meso-zeaxanthin, and where does it come from? Eye (Lond). 2013 Aug;27(8):899-905. doi: 10.1038/eye.2013.98. Epub 2013 May 24. PMID: 23703634; PMCID: PMC3740325.



WHERE IS MESO-ZEAXANTHIN FOUND?

Why Is Meso-Zeaxanthin Added To Supplements?

Some people cannot convert Lutein into Meso-Zeaxanthin. This condition, present in roughly 20 percent of patients, is particularly prevalent in those with AMD

A “Golden Formula” was tested by the CREST (Central Retinal Enrichment Supplement Trials) study which used supplements containing the following amounts of carotenoids:

**10mg Lutein
10mg Meso-zeaxanthin
2mg Zeaxanthin**

Akuffo KO, Beatty S, Stack J, Dennison J, O'Regan S, Meagher KA, Peto T, Nolan J. Central Retinal Enrichment Supplementation Trials (CREST): design and methodology of the CREST randomized controlled trials. *Ophthalmic Epidemiol.* 2014 Apr;21(2):111-23. doi: 10.3109/09286586.2014.888085. PMID: 24621122; PMCID: PMC4002658.

The CREST Study

The aim was to investigate the potential impact of macular pigment enrichment, following supplementation with a formulation containing 10 mg lutein (L), 2 mg zeaxanthin (Z) and 10 mg meso-zeaxanthin (MZ), on visual function in normal subjects (Trial 1) and in subjects with early age-related macular degeneration (Trial 2)

***Trial 1:* Does supplementation with all three macular carotenoids in a ratio (mg/day) of 10:10:2 (L:MZ:Z), for 12 months, enhance visual function in normal subjects (without retinal disease) when compared to placebo?**

***Trial 2:* Does supplementation with all three macular carotenoids in a ratio (mg/day) of 10:10:2 (L:MZ:Z) plus 500 mg vitamin C, 400 IU vitamin E, 25 mg zinc and 2 mg copper for 24 months, enhance visual function in patients with early AMD when compared to 10:2 (L:Z) plus 500 mg vitamin C, 400 IU vitamin E, 25 mg zinc and 2 mg copper.**

The CREST Study - Results

Primary Outcome Measure: Contrast Sensitivity

Secondary Measures: Visual Acuity, Disability Glare, Photostress Recovery, Macula Pigment levels, Light Scatter, Foveal Architecture, Serum Carotenoid Concentrations, Subjective Visual Function, and Cognitive Function. In Trial 2, AMD Morphology, Reading Acuity and Reading Speed are also being assessed

There was a statistically significant improvement in the primary outcome measure and statistically significant improvements in several secondary outcome visual function measures

Cognitive Function and Its Relationship with Macular Pigment Optical Density and Serum Concentrations of its Constituent Carotenoids

David Kelly^{a,*}, Robert F. Coen^b, Kwadwo Owusu Akuffoa, Stephen Beatty^{a,c}, Jessica Dennison^a, Rachel Morana, Jim Stacka, Alan N. Howard^d, Riona Mulcahy^e and John M. Nolan^a
^aMacular Pigment Research Group, Department of Chemical and Life Sciences, Waterford Institute of Technology, Waterford, Ireland ^bMemory Clinic, Mercers Institute for Research on Ageing, St. James's Hospital, Dublin, Ireland ^cInstitute of Vision Research, Whitfield Clinic, Waterford, Ireland ^dHoward Foundation, Cambridge, UK ^eUniversity Hospital Waterford, Age-Related Care Unit, Waterford, Ireland

Lutein and Zeaxanthin are present in brain tissue (specifically the cerebellum, pons, and the frontal/occipital cortices, hippocampus and prefrontal and auditory cortices of human brain tissue)

Macula Pigment levels correlate with concentrations of Lutein and Zeaxanthin (particularly Lutein) in the primate brain

This has led researchers to speculate that the macular carotenoids may also have an antioxidant role in the brain, similar to that in the human retina

MACULA PIGMENT & COGNITIVE FUNCTION

Macula Pigment & Cognitive Function

Possible functions of carotenoids in the brain include; antioxidant; anti-inflammatory; structural and functional enhancement of synaptic membranes and gap junction communication, and thereby may ultimately protect against insult to cognition

Research has shown that patients with mild to moderate Alzheimer's disease exhibit significantly less Macula Pigment, poorer vision, and a higher occurrence of AMD when compared to control subjects

Moreover, in a subsequent clinical trial, it was found that supplementation with the macular carotenoids (MZ, Z, and L) benefited patients with Alzheimer's Disease, in terms of increases in Macula Pigment and in terms of clinically meaningful improvements in visual function

Cognitive Function and Its Relationship with Macular Pigment Optical Density and Serum Concentrations of its Constituent Carotenoids David Kelly^{a,*}, Robert F. Coen^b, Kwadwo Owusu Akuffo^a, Stephen Beatty^{a,c}, Jessica Dennison^a, Rachel Morana, Jim Stacka, Alan N. Howard^d, Riona Mulcahy^e and John M. Nolan^a ^aMacular Pigment Research Group, Department of Chemical and Life Sciences, Waterford Institute of Technology, Waterford, Ireland ^bMemory Clinic, Mercers Institute for Research on Ageing, St. James's Hospital, Dublin, Ireland ^cInstitute of Vision Research, Whitfield Clinic, Waterford, Ireland ^dHoward Foundation, Cambridge, UK ^eUniversity Hospital Waterford, Age-Related Care Unit, Waterford, Ireland

Macula Pigment & Cognitive Function

In another example, Rinaldi et al. have shown that in patients with Alzheimer's Disease, plasma concentrations of Lutein and Zeaxanthin were lower in comparison to control subjects, with a significant and inverse relationship observed between Lutein concentrations and dementia severity

In another study, supplemental Lutein resulted in improved performance in a range of cognitive tests in unimpaired older women

It has been shown that a positive relationship exists between Macula Pigment levels and cognitive performance in unimpaired and mildly cognitively impaired adults

Recent work has also shown that Macula Pigment levels are significantly related to better global cognition, verbal learning and fluency, recall, and processing and perceptual speed, whereas serum Lutein and Zeaxanthin levels were only significantly related to verbal fluency in older adults with normal cognitive function

Cognitive Function and Its Relationship with Macular Pigment Optical Density and Serum Concentrations of Its Constituent Carotenoids David Kellya,*, Robert F. Coenb, Kwadwo Owusu Akuffoa, Stephen Beattyac, Jessica Dennisona, Rachel Morana, Jim Stacka, Alan N. Howardd, Riona Mulcahye and John M. Nolana aMacular Pigment Research Group, Department of Chemical and Life Sciences, Waterford Institute of Technology, Waterford, Ireland bMemory Clinic, Mercers Institute for Research on Ageing, St. James's Hospital, Dublin, Ireland cInstitute of Vision Research, Whitfield Clinic, Waterford, Ireland dHoward Foundation, Cambridge, UK eUniversity Hospital Waterford, Age-Related Care Unit, Waterford, Ireland

Macula Pigment & Cognitive Function

“Taken together, these studies suggest that Macula Pigment’s constituent carotenoids may play a role in cognitive function, and given the relationship between MP and brain carotenoid levels, it is reasonable to hypothesize that MP could be used as a biomarker for cognitive function and/or Alzheimer’s Disease; however, additional study in this area is needed.”

Cognitive Function and Its Relationship with Macular Pigment Optical Density and Serum Concentrations of its Constituent Carotenoids David Kelly^{a,*}, Robert F. Coen^b, Kwadwo Owusu Akuffo^a, Stephen Beatty^{a,c}, Jessica Dennison^a, Rachel Morana, Jim Stacka, Alan N. Howard^d, Riona Mulcahy^e and John M. Nolan^a ^aMacular Pigment Research Group, Department of Chemical and Life Sciences, Waterford Institute of Technology, Waterford, Ireland ^bMemory Clinic, Mercers Institute for Research on Ageing, St. James’s Hospital, Dublin, Ireland ^cInstitute of Vision Research, Whitfield Clinic, Waterford, Ireland ^dHoward Foundation, Cambridge, UK ^eUniversity Hospital Waterford, Age-Related Care Unit, Waterford, Ireland

Summary

- **The average UK diet is lacking in all of the micro nutrients we need for optimal health**
- **Supplements can provide the extra micro nutrients required for optimal eye health**
- **Diet should always come first – supplements are an addition to a healthy diet, not a substitute**
- **Supplements based on AREDS 2 are proven to be effective at slowing the progression from moderate to severe AMD – but will not prevent or cure AMD**
- **The addition of Meso-Zeaxanthin with the 10:10:2 formula have shown improvements in visual outcomes for patients with and without AMD**
- **There is strong correlation between Macula Pigment levels and Alzheimer's Disease, with improvements in cognitive function measures being reported when using AREDS 2 formula supplements with the inclusion of Meso-Zeaxanthin (10:10:2)**
- **However, more research is required in this field to prove the apparent links**



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