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Nutrition for Eye Health

Mechanisms, Triggers & Clinical Interventions

Webinar - 24th March 2026

Sue Camp

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MSC, B.SocSci (Hons), IFMCP, Registered Nutritionist (BANT) and Registered Nutritional Therapist (CNHC)

- Specialise in gut health, hormone health and optimising health and performance
- Run my own practice, corporate consultant, and lead the nutrition team for the HealthMatters Group
- Completing an International Masters in Clinical Psychoneuroimmunology (cPNI) with the Pruimboom Institute
- Avid Parkrunner and enthusiastic kayaker
- Enjoy the balance between hot yoga and dark chocolate!

Learning outcomes

1. Understand the anatomy and metabolic demands of the eye
2. Detail the role of oxidative stress, glycation, inflammation, and vascular dysfunction in ocular health
3. Review Age-Related Macular Degeneration (AMD), Dry Eye Disease (DED) and Diabetic Retinopathy (DR)
4. Provide the evidence base for nutrition and targeted nutrients
5. Explore lifestyle Interventions

Prevalence of ocular disease

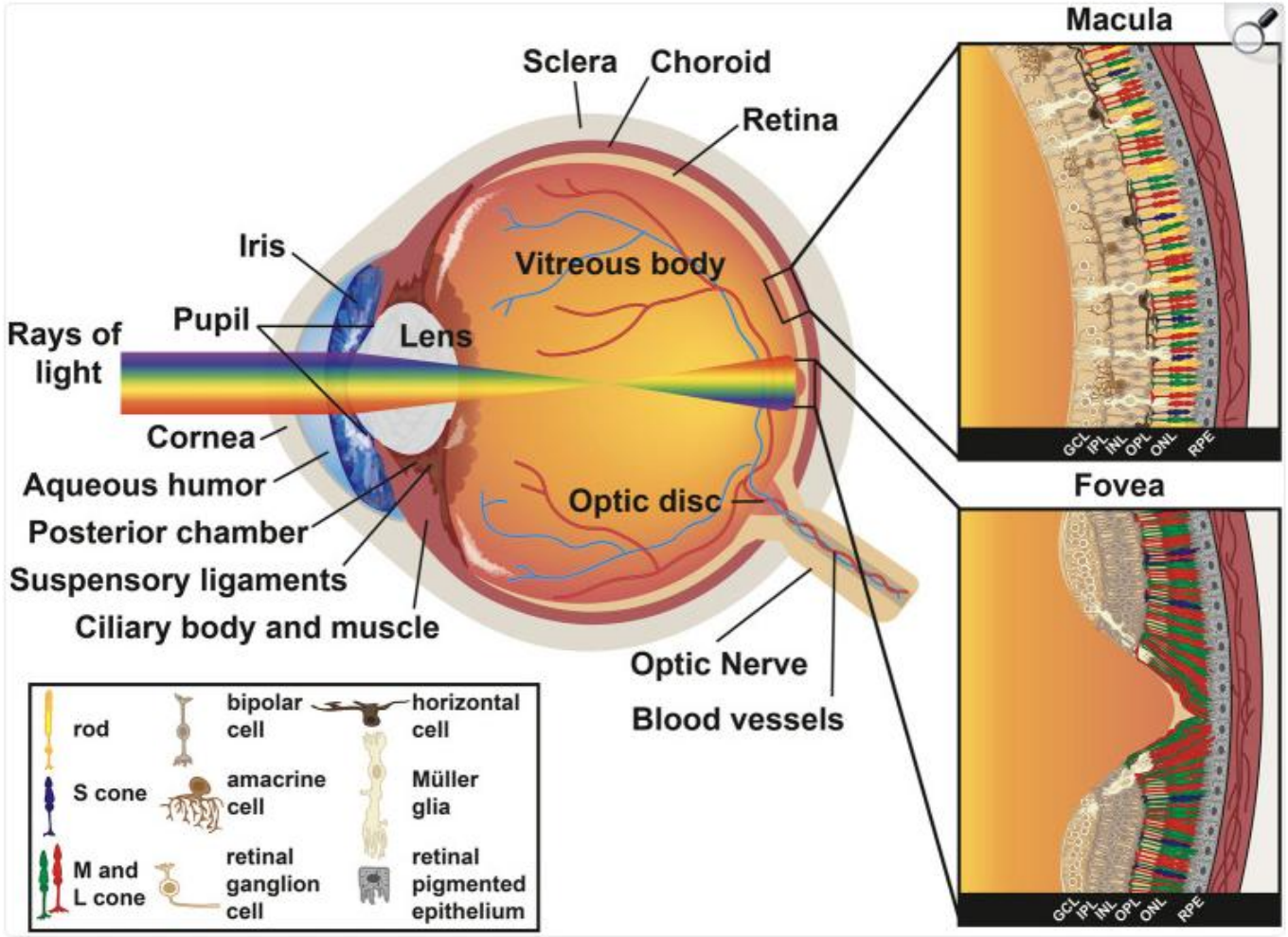
- **Ocular disease is at an epidemic level** in both developing and developed countries
- 2020 estimated 596 million people - distance vision impairment worldwide, of whom 43 million were blind.
- By 2050, population ageing, growth, and urbanisation → estimated 895 million people with distance vision impairment, of whom 61 million will be blind.
- *"Almost everyone will experience impaired vision or an eye condition during their lifetime and require eye care services"*
- Action to prioritise eye health is needed now

Vision decline and age-related eye disorders are rising globally, driven by:

- Ageing populations
- Hyperglycaemia, chronic inflammation and oxidative stress
- Environmental light exposure and screens
- Sedentary behaviour

Burton MJ, et el., The Lancet Global Health Commission on Global Eye Health: vision beyond 2020. Lancet Glob Health. 2021 Apr;9(4):e489-e551. doi: 10.1016/S2214-109X(20)30488-5. Epub 2021 Feb 16.

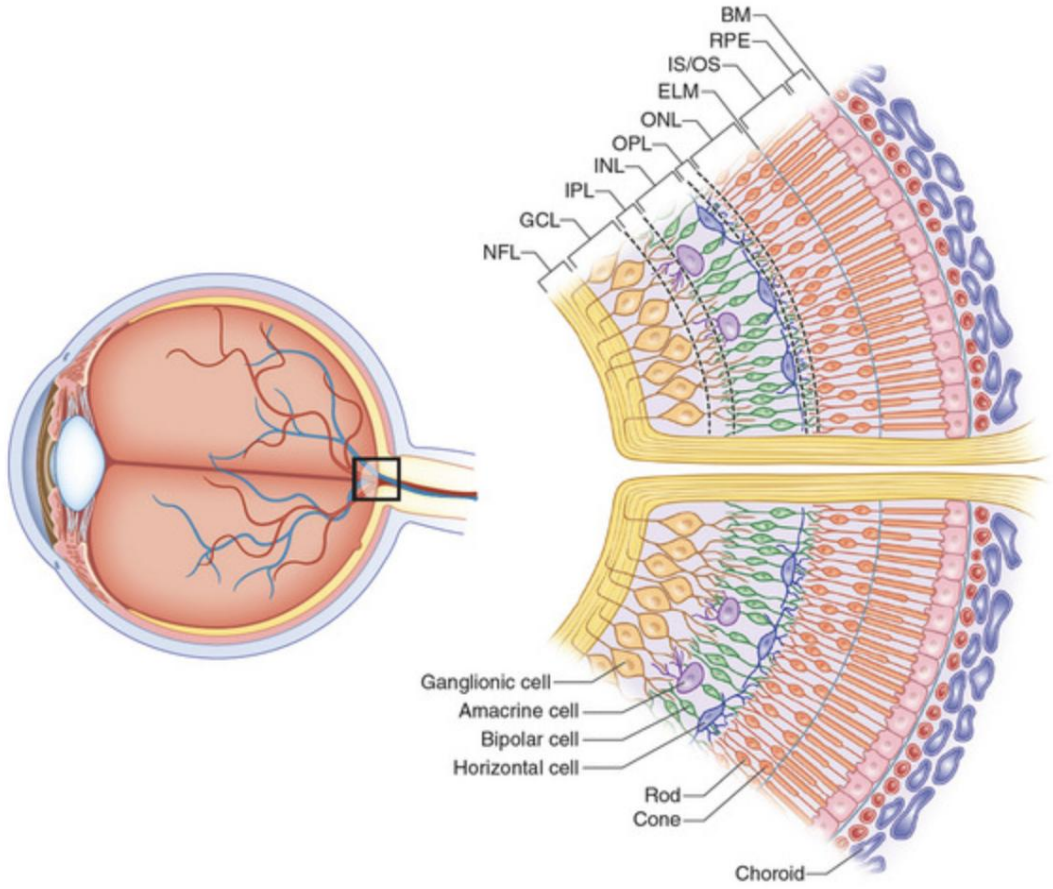
The anatomy of the eye



- The human camera eye relies on the cornea and lens to focus light onto the retina, a tissue located in the back of the eye.
- Vision begins with the detection of light by photoreceptor cells in the retina, a light-sensitive tissue located at the back of the eye.
- Photoreceptor types are defined by morphology, gene expression, light sensitivity, and function.

Hussey KA, Hadyniak SE, Johnston RJ Jr. Patterning and Development of Photoreceptors in the Human Retina. Front Cell Dev Biol. 2022 Apr 14;10:878350. doi: 10.3389/fcell.2022.878350.

The anatomy of the eye



- A cross section through the retina shows **10 neuronal layers and different cell lines**
- Photoreceptor cells include rods and cones.
- Rod photoreceptors function in low-light vision and motion detection
- Cone photoreceptors are responsible for high-acuity daytime and trichromatic colour vision

Hussey KA, Hadyniak SE, Johnston RJ Jr. Patterning and Development of Photoreceptors in the Human Retina. Front Cell Dev Biol. 2022 Apr 14;10:878350. doi: 10.3389/fcell.2022.878350.
https://www.retinareference.com/anatomy/

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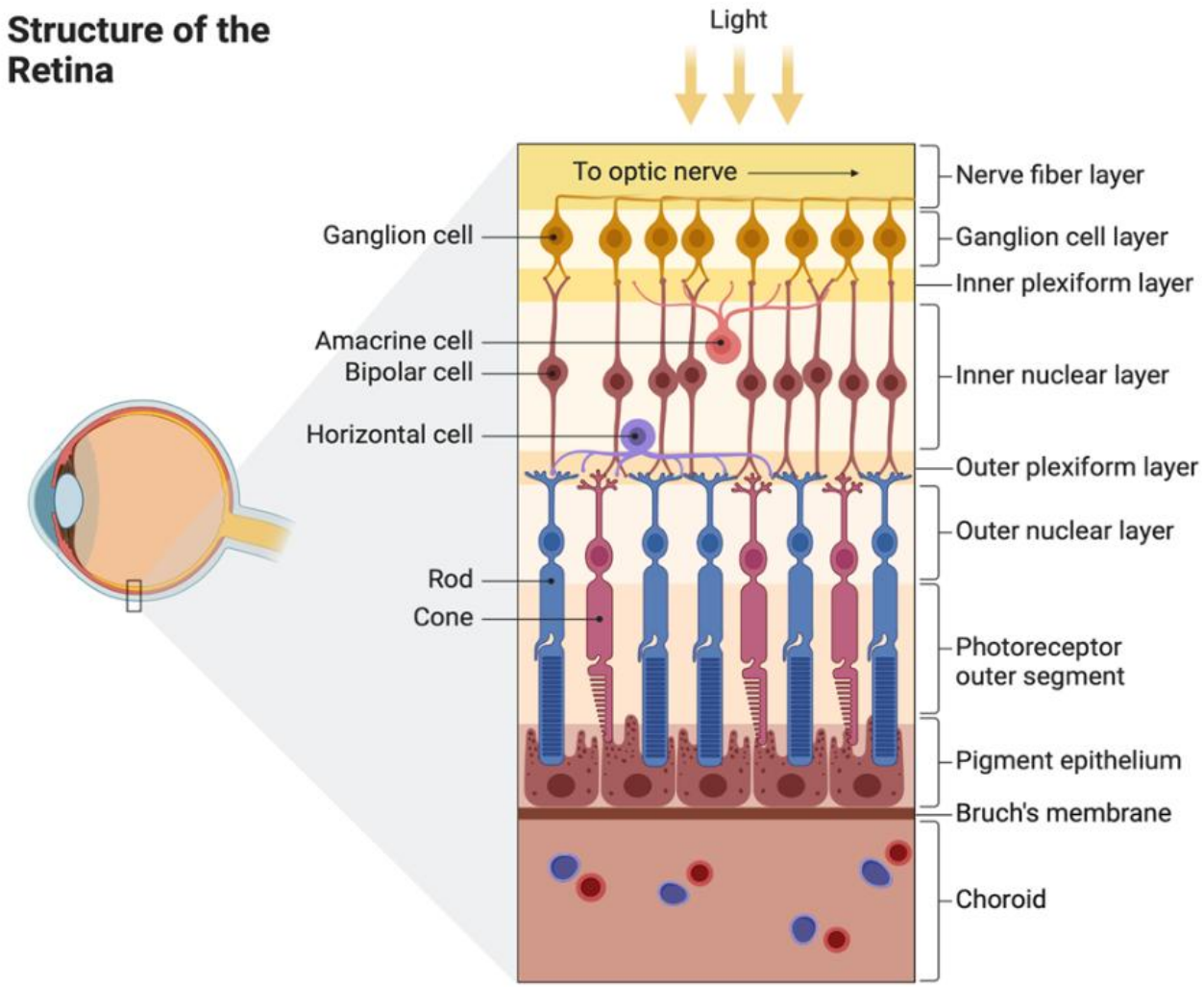
The anatomy of the eye



- Neuronal layers are connected to one another via synapses
- Each cell line plays a role in detecting variations and movements of light

Wu KY, et al. A. Cell Therapy for Retinal Degenerative Diseases: Progress and Prospects. Pharmaceutics. 2024 Oct 5;16(10):1299. doi: 10.3390/pharmaceutics16101299.

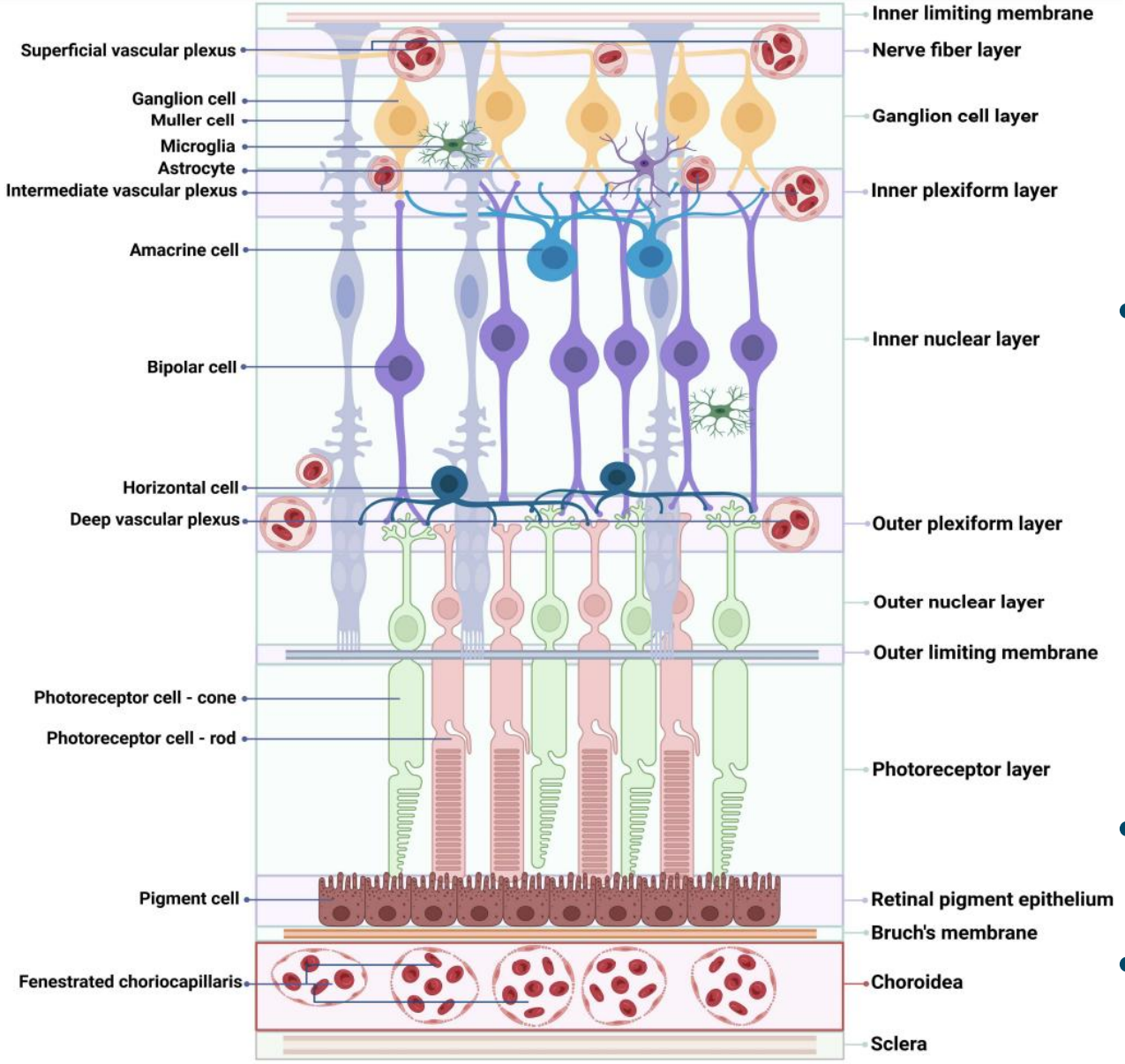
The eye as a metabolic organ

The retina is one of the most **metabolically active and highest energy-consuming organs**, exceeding the metabolic rate of the brain

Ocular tissues are uniquely vulnerable to:

- Oxidative stress (generation of Reactive Oxygen Species ROS))
- Glycation and AGE formation (Advanced Glycation End-Products)
- Mitochondrial dysfunction
- Microvascular inflammation
- Lipid peroxidation

Joyal JS, Gantner ML, Smith LEH. Retinal energy demands control vascular supply of the retina in development and disease: The role of neuronal lipid and glucose metabolism. Prog Retin Eye Res. 2018 May;64:131-156. doi: 10.1016/j.preteyeres.2017.11.002.
Singh C. Metabolism and Vascular Retinopathies: Current Perspectives and Future Directions. Diagnostics (Basel). 2022 Apr 5;12(4):903. doi: 10.3390/diagnostics12040903.

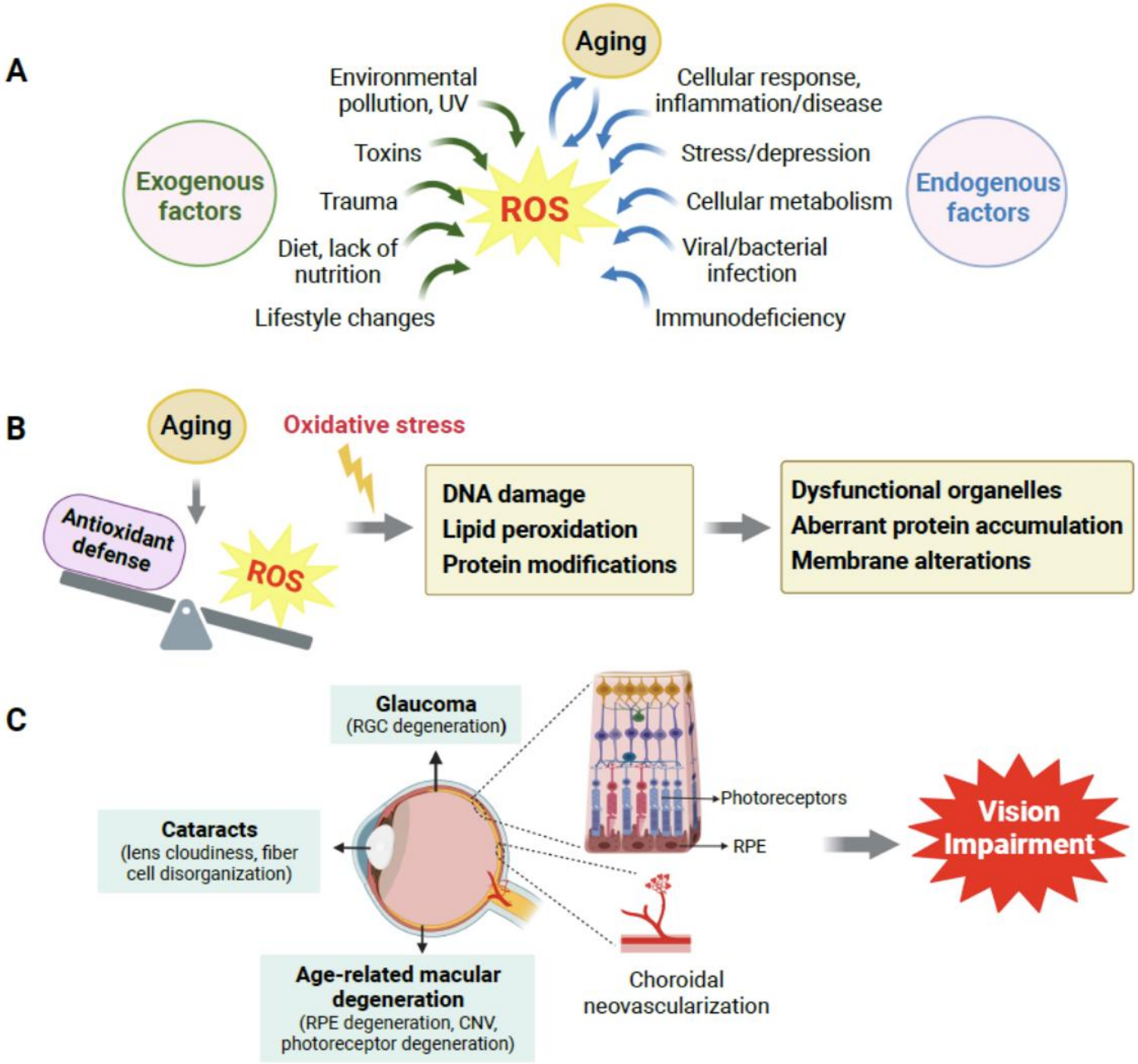


Blood Retinal Barrier

- BRB tightly regulates what enters the neural retina & comprises inner and outer components:
  - The inner BRB - formed by tight junctions between retinal vascular endothelial cells
  - The outer BRB - formed by the retinal pigment epithelium (RPE)
- Disruption of the BRB - key early event in conditions like DR & AMD
- Integrity of this barrier is a central target for nutritional intervention

Srejovic JV, et al. Molecular and Cellular Mechanisms Involved in the Pathophysiology of Retinal Vascular Disease—Interplay Between Inflammation and Oxidative Stress. *International Journal of Molecular Sciences*. 2024; 25(21):11850. https://doi.org/10.3390/ijms252111850

Impacts on eye health



Exogenous and endogenous factors, aging, oxidative stress cause oxidative damage to multiple types of ocular cells → onset and progression of ocular disorders & vision impairment

Kushwah N, et al., Oxidative Stress and Antioxidants in Age-Related Macular Degeneration. Antioxidants (Basel). 2023 Jul 3;12(7):1379.

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Core Pathological Mechanisms

Interconnected mechanisms:

- Oxidative stress
- Hyperglycaemia → glycation
- Mitochondrial dysfunction
- Microvascular inflammation

Understanding each mechanism — and how they interact — is essential for designing effective nutritional interventions

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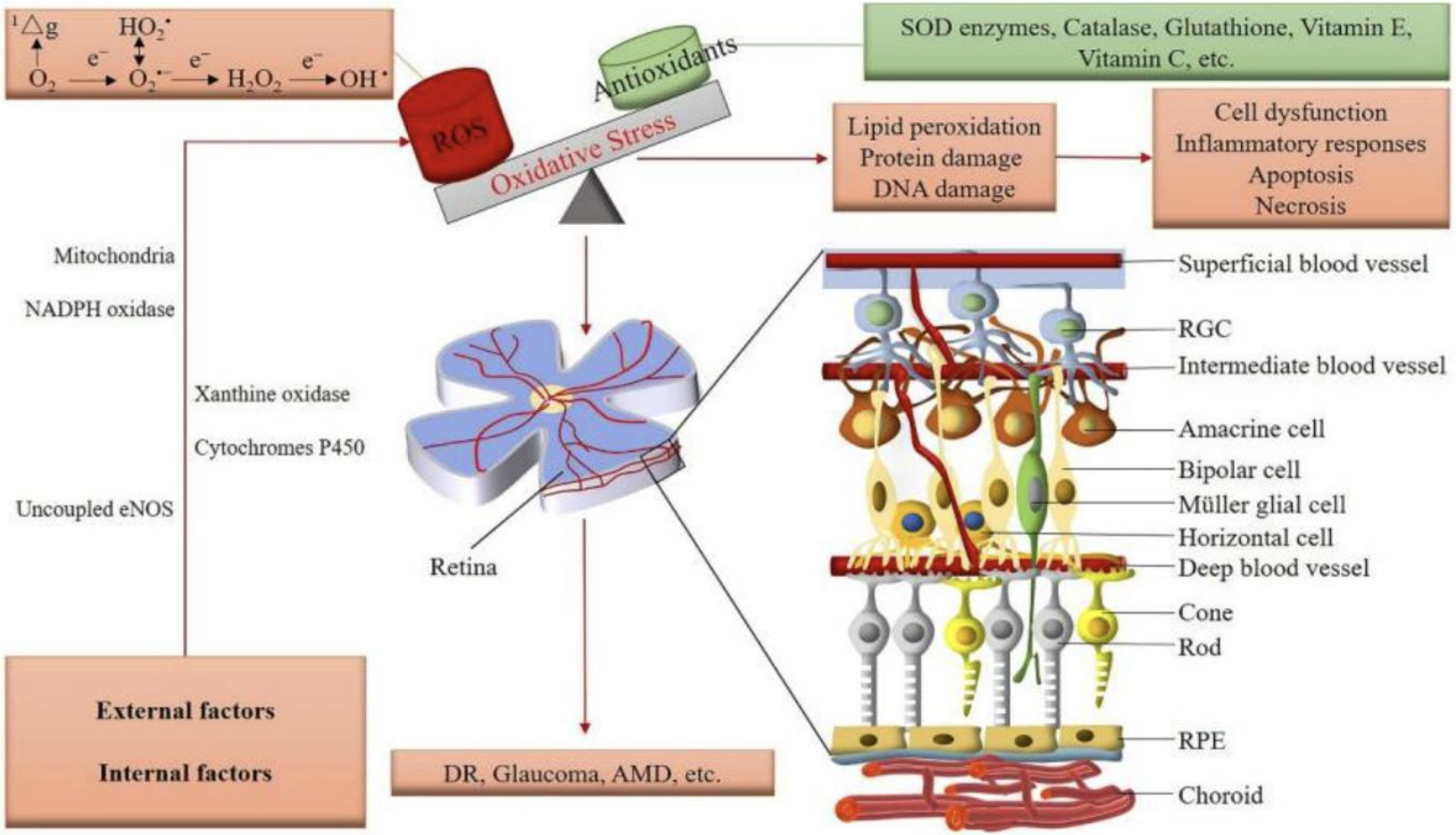
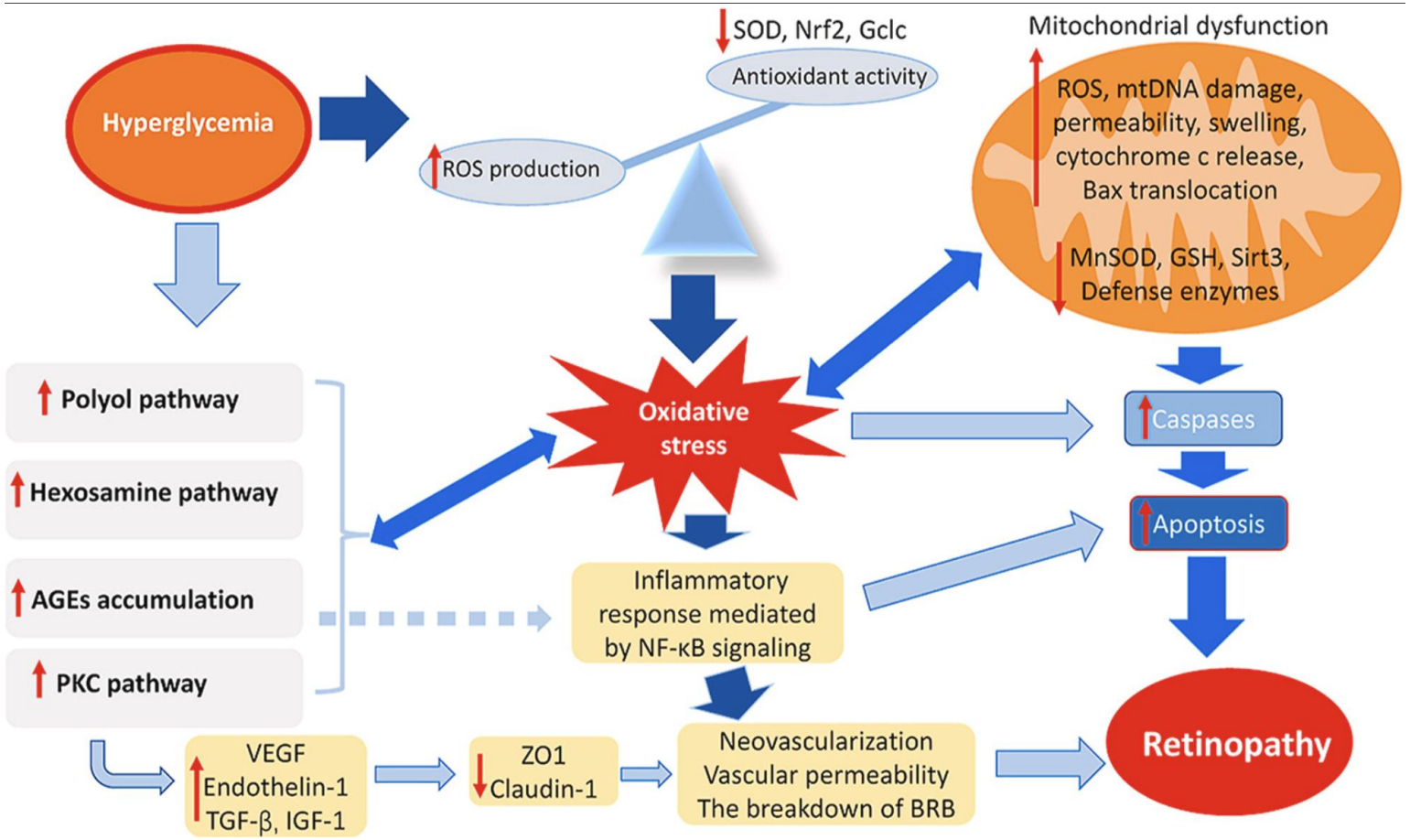
Oxidative Stress

- External and internal factors contribute to ROS generation
- Balance between ROS & AO
- Impact on the retinal neurovascular unit:
  - Damage to blood vessels, retinal cells, degeneration of photoreceptors, impairment of the RPE, and compromise of the choroidal circulation
- Oxidative stress is a **central unifying mechanism** in retinal pathology



Ruan Y, Jiang S, Musayeva A, Gericke A. Oxidative Stress and Vascular Dysfunction in the Retina: Therapeutic Strategies. Antioxidants (Basel). 2020 Aug 17;9(8):761. doi: 10.3390/antiox9080761.

Hyperglycaemia



Hyperglycaemia drives four interlinked metabolic pathways all of which converge on ROS generation and oxidative stress, accelerating the pathogenesis of diabetic retinopathy

Kang Q, Yang C. Oxidative stress and diabetic retinopathy: Molecular mechanisms, pathogenetic role and therapeutic implications. Redox Biol. 2020 Oct;37:101799. doi: 10.1016/j.redox.2020.101799.

Mitochondrial dysfunction

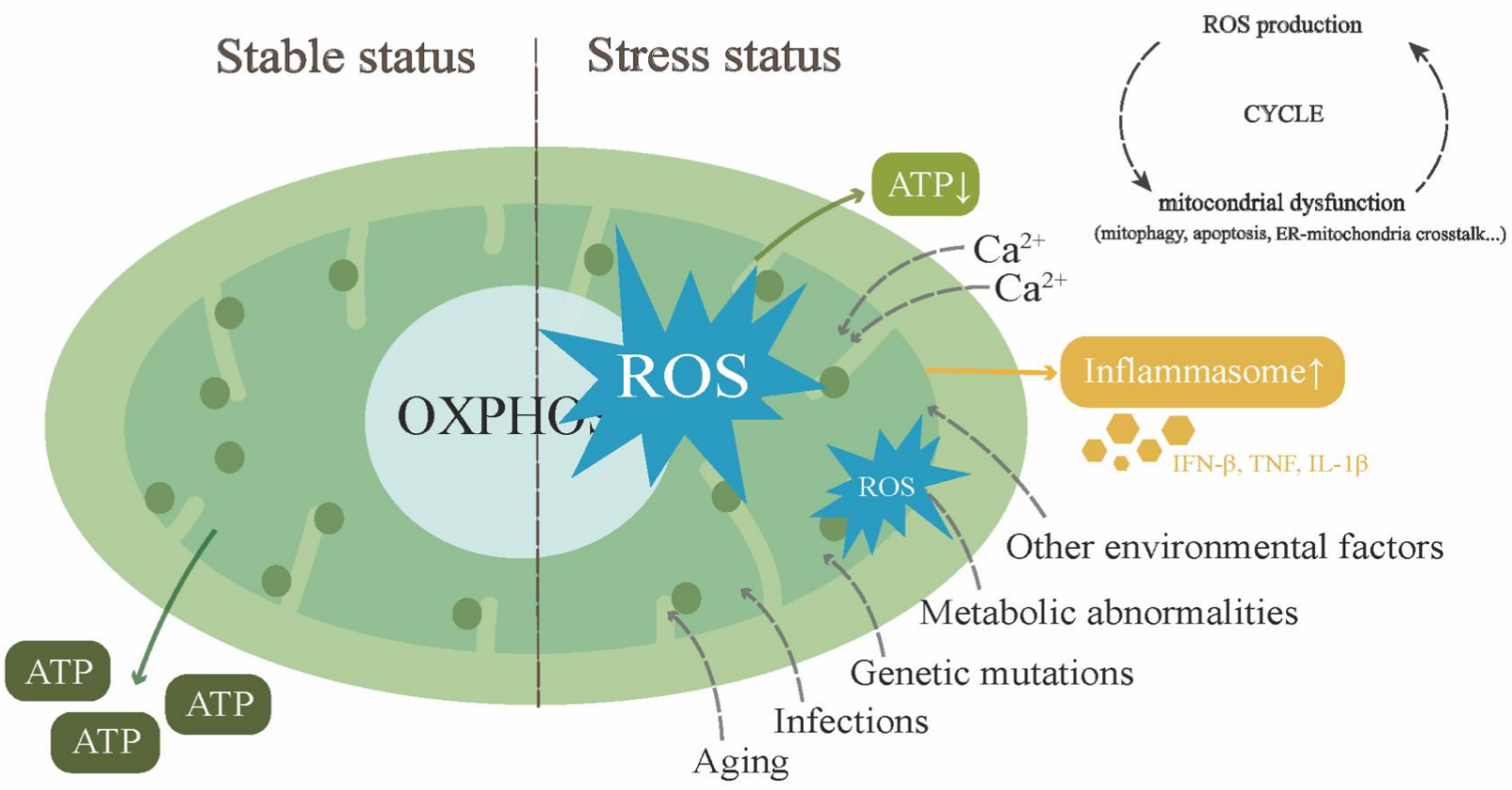
- Mitochondria → crucial energy production → intimately associated with ocular function
- Disruption of mitochondrial function → implicated in pathogenesis of ocular diseases
- Conditions often arise from an imbalance in mitochondrial homeostasis
- Encompasses impaired mitochondrial quality control, excessive production of ROS, and dysregulated mitochondrial calcium signalling

Key drivers of mitochondrial dysfunction in ocular tissue:

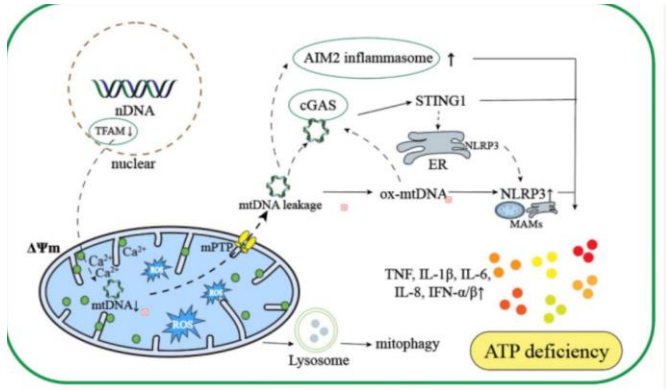
- Chronic oxidative stress and mtDNA damage
- Nutrient deficiencies — CoQ10, B vitamins, magnesium, alpha-lipoic acid
- High-glucose environments (diabetes, metabolic syndrome)
- Age-related decline in mitochondrial biogenesis

Sun H, et al., Imbalanced mitochondrial homeostasis in ocular diseases: unique pathogenesis and targeted therapy. Exp Eye Res. 2025 Nov;260:110632. doi: 10.1016/j.exer.2025.110632.

Mitochondrial dysfunction



- Mitochondria under stable status → ATP
- Under stress status → large amounts of ROS, inflammasomes and reduced production of ATP



Chen X, Hong J, Le Q. Role of mitochondrial dysfunction in ocular surface diseases. Cell Stress. 2025 Aug 5;9:174-181. doi: 10.15698/cst2025.08.309.

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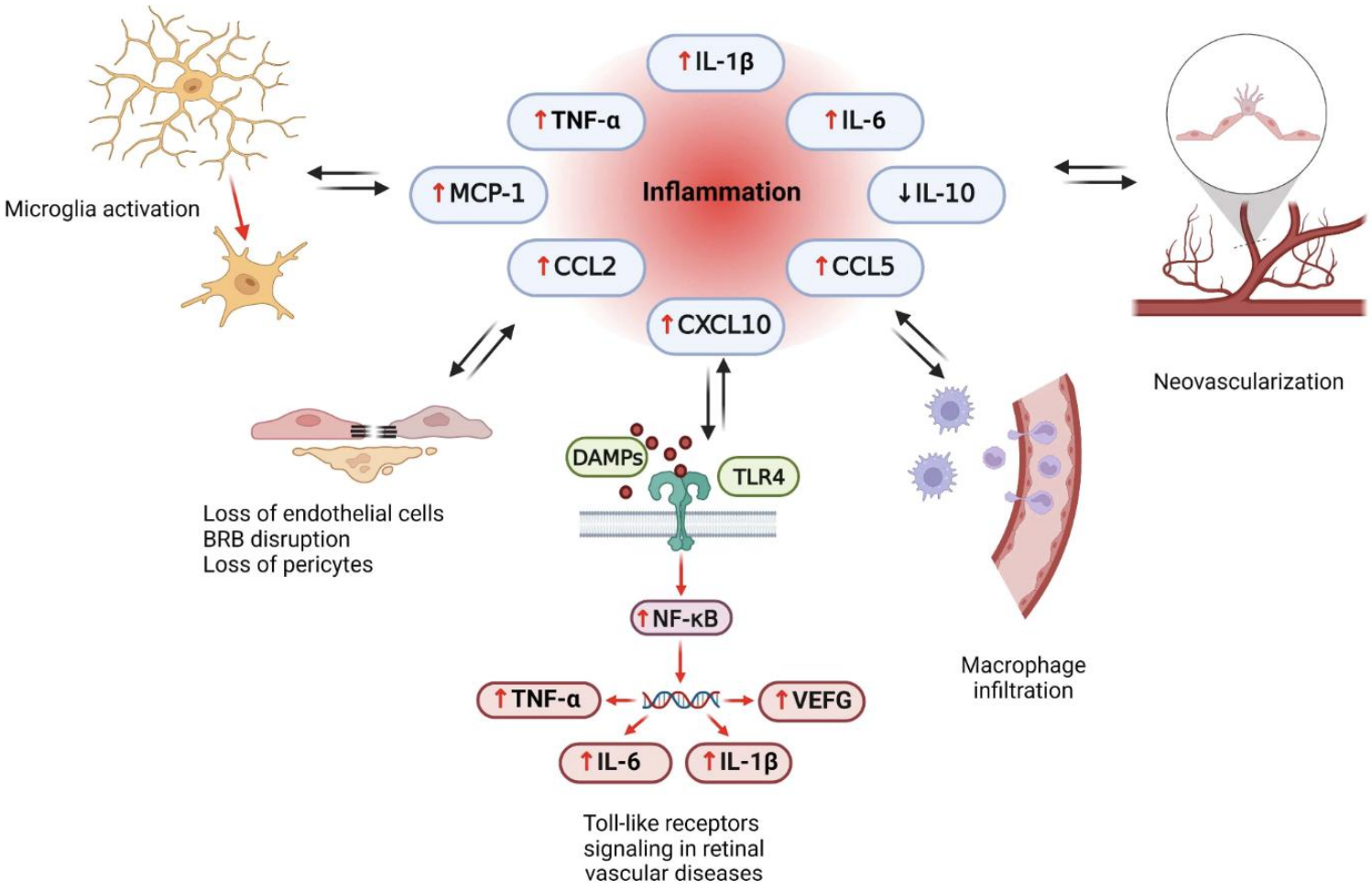
Microvascular Inflammation



Inflammatory pathways trigger microglia activation → release pro-inflammatory cytokines, damage BRB

DAMPs and PAMPs trigger NFkB and inflammatory loop

Downstream effects →

- Pro-inflammatory macrophage infiltration
- Neovascularization - abnormal, disorganised vessel growth triggered by disease

Srejovic JV, et al. Molecular and Cellular Mechanisms Involved in the Pathophysiology of Retinal Vascular Disease—Interplay Between Inflammation and Oxidative Stress. *International Journal of Molecular Sciences*. 2024; 25(21):11850. https://doi.org/10.3390/ijms252111850

Key Clinical Insight

Vision decline rarely occurs in isolation.

When a client presents with deteriorating visual function — whether macular, vascular, or lens-related — consider the systemic metabolic context:

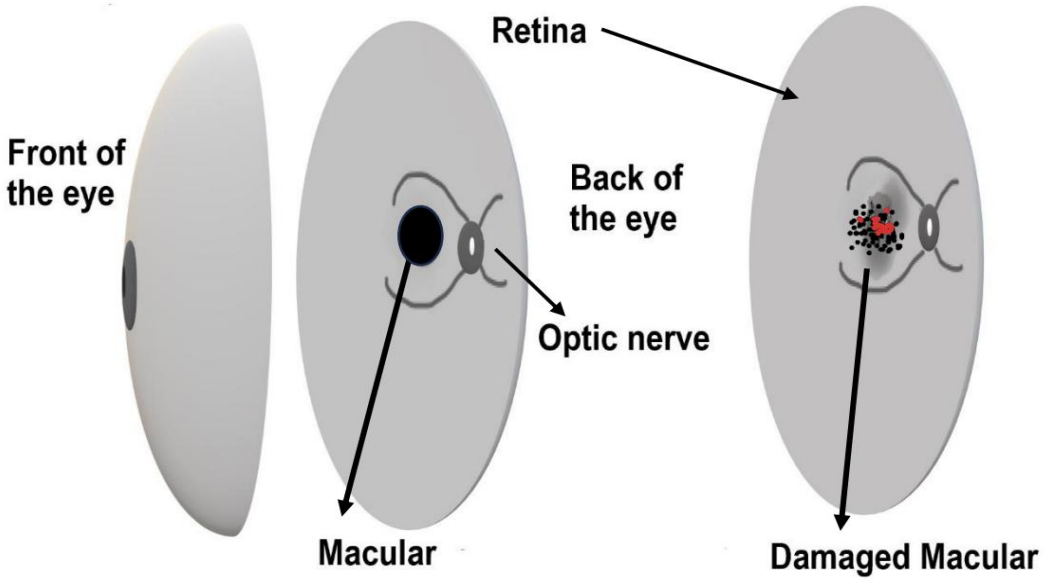
- Are there signs of oxidative stress load?
- Is blood glucose control adequate?
- Are inflammatory markers elevated?
- Are omega-3 and antioxidant levels optimal?

Addressing these upstream factors can significantly alter the trajectory of ocular decline.

Age-related Macular Degeneration (AMD)

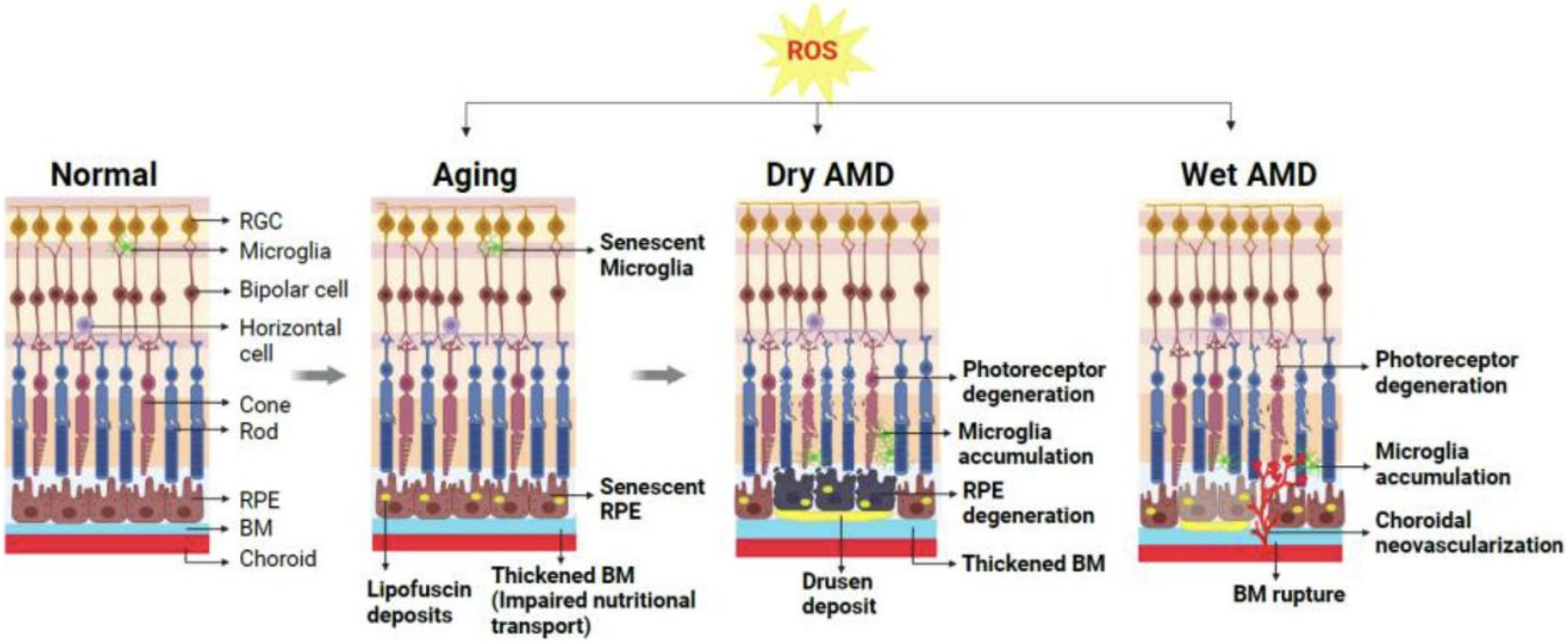
- Leading cause of visual impairment, severe vision loss and legal blindness in the industrialised world
- Characterised by progressive degeneration of the macula — the central retina responsible for fine detail and colour vision
- Accumulation of extracellular deposits (drusen) and progressive degeneration of photoreceptors and adjacent tissues
- Clinically classified as early-stage (medium-sized drusen and retinal pigmentary changes) to late-stage (neovascular and atrophic)

- There are 2 types of AMD:
  - Non-neovascular or dry AMD
  - Neovascular or wet AMD

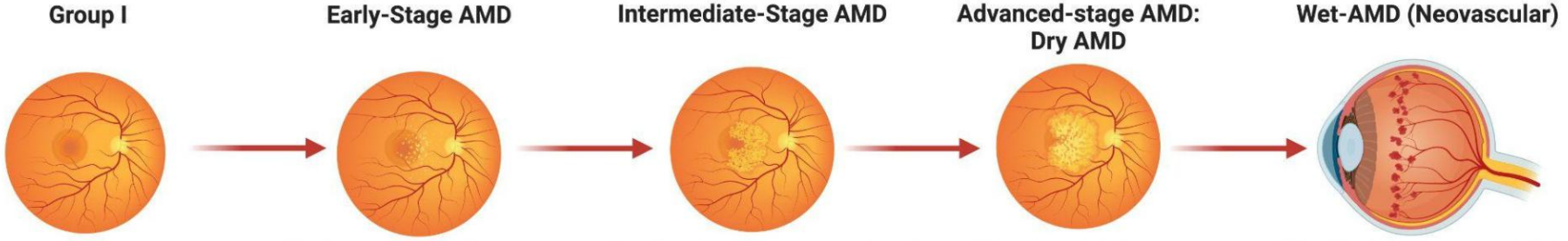


Fleckenstein, M., Keenan, T.D.L., Guymer, R.H. *et al.* Age-related macular degeneration. *Nat Rev Dis Primers* **7**, 31 (2021). https://doi.org/10.1038/s41572-021-00265-2

Dry and Wet AMD



Stages of Age-Related Macular Degeneration(AMD) and Associated Clinical Features



Group I

Five to fifteen small lesions

Early-Stage AMD

Minimal or no vision loss, with the presence of small drusen:

- > 15 small lesions OR
- < 20 medium-sized lesions

Intermediate-Stage AMD

Moderate vision loss, difficulty seeing in low light, and an increased number of medium-sized drusen:

- At least one large lesion OR
- More than 20 medium-sized lesions OR
- Non-central geographic atrophy (GA)

Advanced-stage AMD: Dry AMD

Significant vision loss, central vision affected, and presence of large drusen or central GA

Wet-AMD (Neovascular)

Rapid vision loss, possible distortion of central vision, and presence of choroidal neovascularization

Kushwah N, et al., Oxidative Stress and Antioxidants in Age-Related Macular Degeneration. Antioxidants (Basel). 2023 Jul 3;12(7):1379

Wu KY, et al., Cell Therapy for Retinal Degenerative Diseases: Progress and Prospects. Pharmaceutics. 2024 Oct 5;16(10):1299. doi: 10.3390/pharmaceutics16101299.

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Age related macular degeneration (AMD)

- Complex interplay between ageing, environmental risk factors & genetics
  - More than 50 genetic susceptibility loci have been identified - *CFH* and *ARMS2* genes
- Mechanisms include:
  - Chronic inflammation
  - Lipid deposition
  - Oxidative stress
  - Impaired extracellular matrix maintenance
- Major non-genetic risk factors are smoking and low dietary intake of antioxidants (zinc and carotenoids)
- Also high blood pressure, high cholesterol, vascular diseases and diabetes

Mitchell P et al., Age-related macular degeneration. Lancet. 2018 Sep 29;392(10153):1147-1159. doi: 10.1016/S0140-6736(18)31550-2.

Dry Eye Disease (DED)

DED - the eyes don't make enough tears, or the tears evaporate too quickly

Leads to the eyes drying out and becoming red, swollen and irritated.

The tear film comprises 3 main layers:

- **Lipid layer:** Oily outer layer, keeps the tear surface smooth and prevents tears from evaporating too quickly.
- **Aqueous layer:** Middle layer and the thickest component; makes up the bulk of tears and cleans the eye
- **Basal layer:** Composed of mucins, or glycoproteins - helps spread the watery layer evenly over the eye's surface, keeping it moist

2 main sub-types:

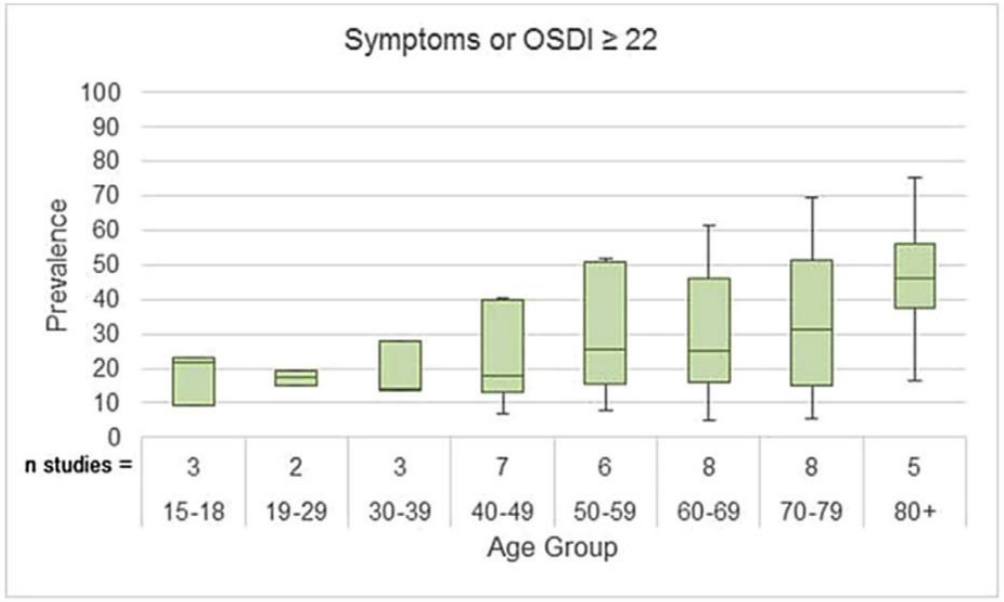
1. **Aqueous-deficient dry eye** — the glands simply don't produce enough tears
2. **Evaporative dry eye** — tears are produced but evaporate too quickly

https://www.ncbi.nlm.nih.gov/books/NBK470411/

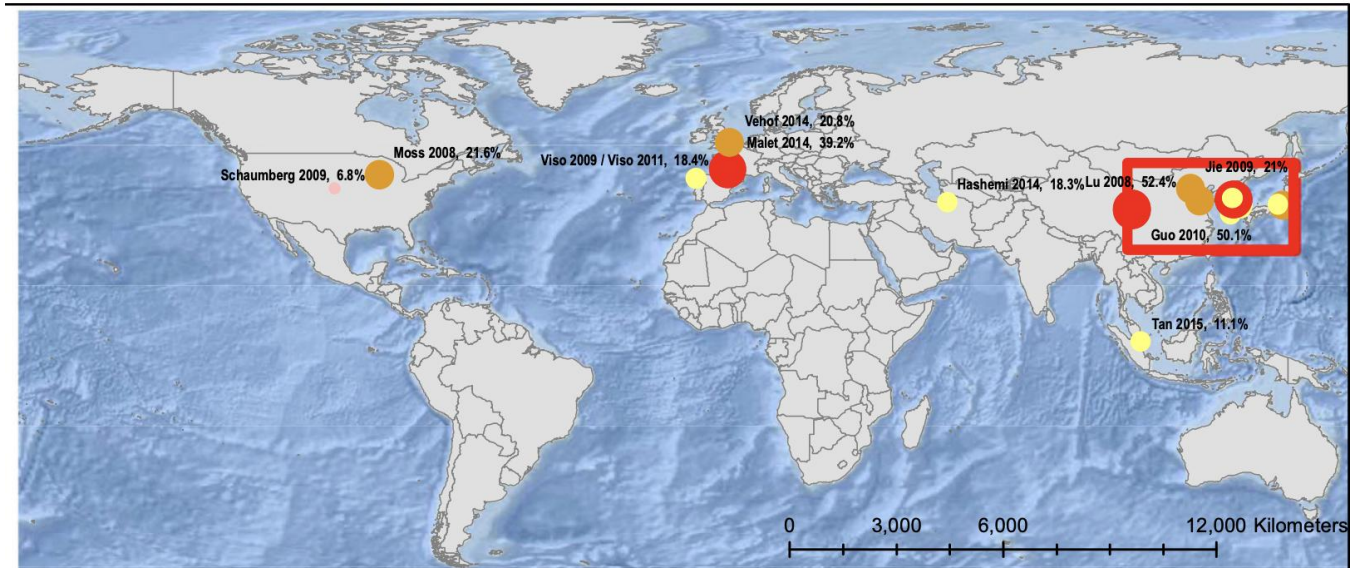
Dry Eye Disease (DED) - Prevalence

Prevalence worldwide varies depending on the diagnostic criteria employed
Ranges from approximately 5% to 50% in population-based studies.

More common in women than men (female hormonal effects on the lacrimal and Meibomian glands and ocular surface) and has an increased prevalence with age.



Symptomatic Disease



Stapleton F et al., TFOS DEWS II Epidemiology Report. Ocul Surf. 2017 Jul;15(3):334-365. doi: 10.1016/j.jtos.2017.05.003.

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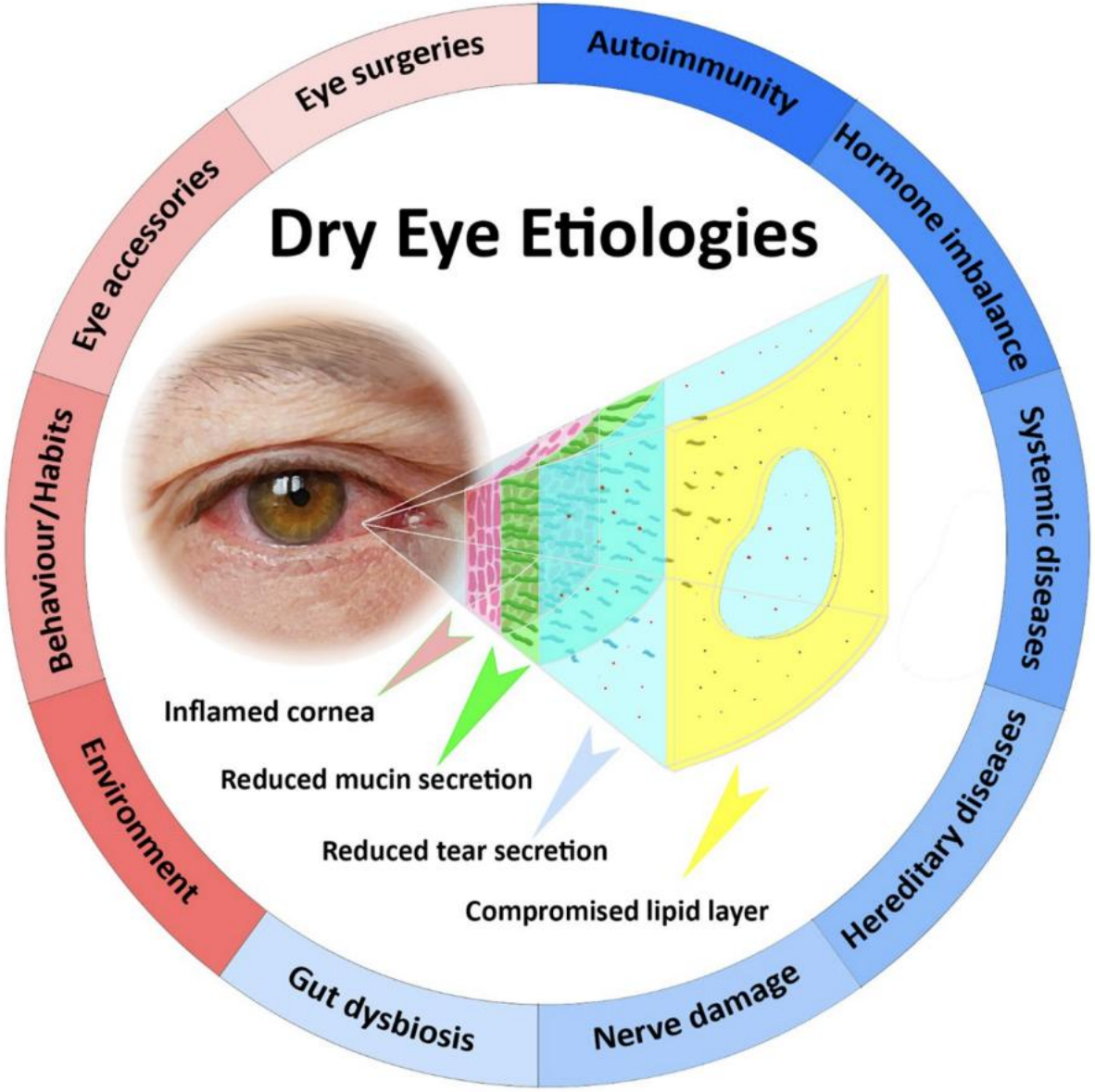
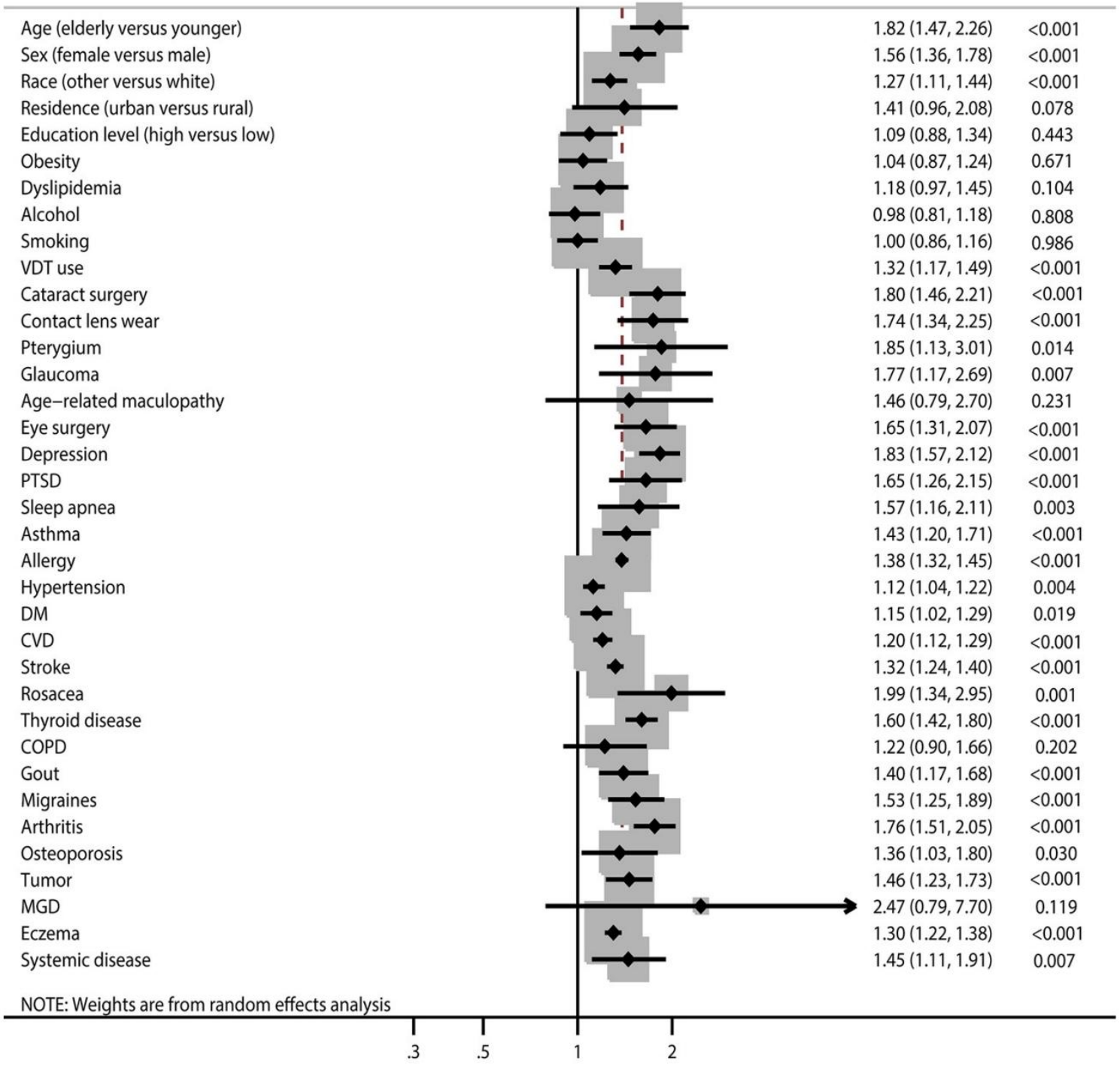
Dry Eye Disease

Schematic of dysregulated tear film during DES and the various intrinsic (blue background) and extrinsic (red background) aetiologies



Huang R, et al., Dry eye syndrome: comprehensive etiologies and recent clinical trials. Int Ophthalmol. 2022 Oct;42(10):3253-3272. doi: 10.1007/s10792-022-02320-7.



Dry Eye Disease - aetiologies

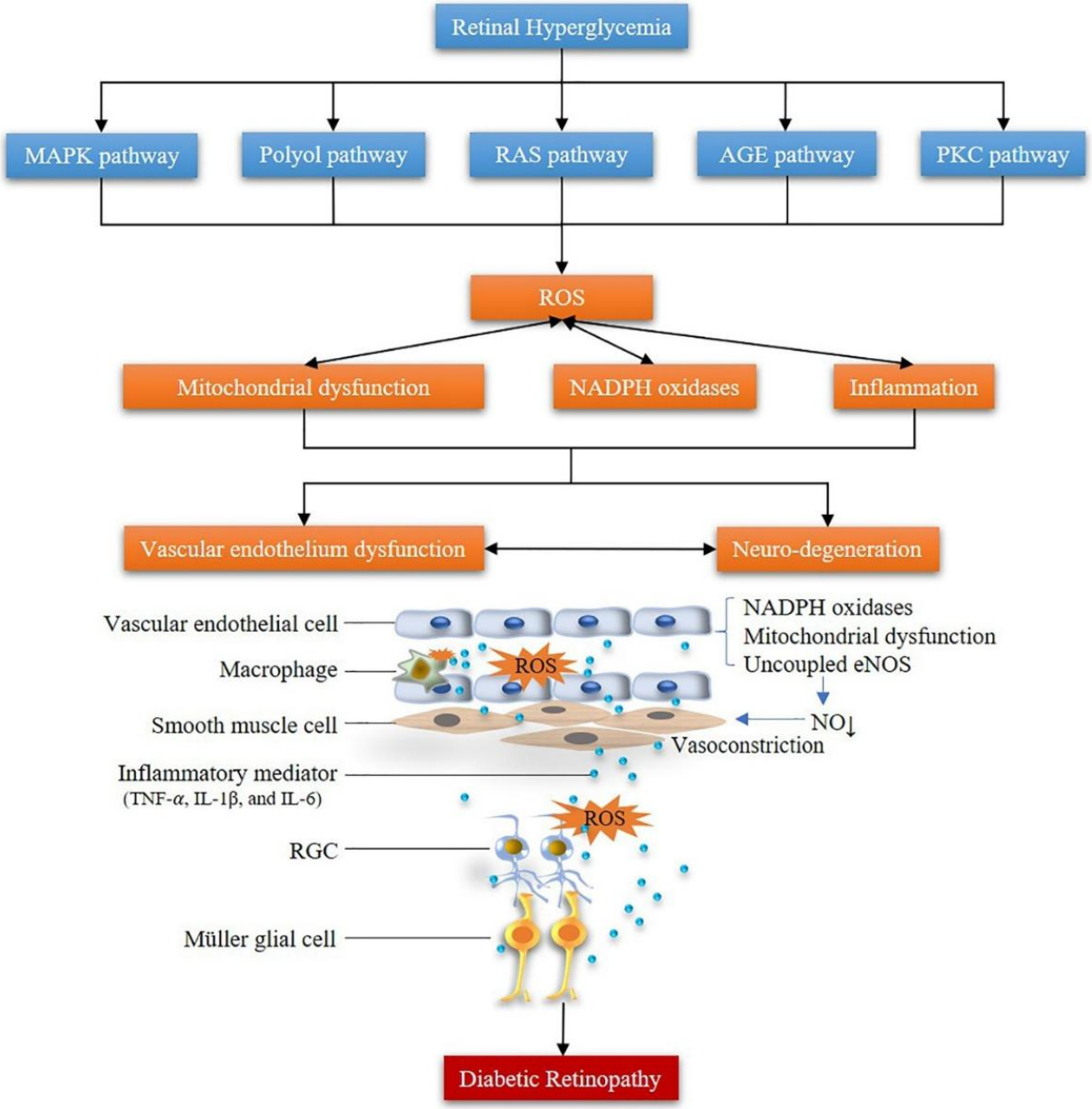
- Meta-analysis- 48 studies; 493,630 individuals
- Older age, female, VDT use, cataract surgery, contact lens, glaucoma, eye surgery, depression, PTSD, sleep apnoea, asthma, allergy, HBP, DM, CVD or stroke, rosacea, thyroid disease, gout, migraines, arthritis, osteoporosis, tumour, eczema, systemic disease

Qian L, Wei W. Identified risk factors for dry eye syndrome: A systematic review and meta-analysis. PLoS One. 2022 Aug 19;17(8):e0271267. doi: 10.1371/journal.pone.0271267.

Diabetic Retinopathy(DR)

- DR - irreversible damage of retinal cells and structures due to chronic diabetes
- Progressive disease influenced by the duration and control of diabetes Development occurs gradually with different degrees of disease severity
- Most common microvascular complication of diabetes
- Leading cause of vision loss in working-age adults globally.
- Approximately 1/3 of diabetics have some degree of retinopathy, and 10-12% have vision-threatening disease
- Diabetics worldwide are predicted to grow to 429 million by 2030, owing to the rising frequency of obesity, increasing life span, and improved detection of the disease.

Antonetti DA, Klein R, Gardner TW. Diabetic retinopathy. N Engl J Med. 2012 Mar 29;366(13):1227-39. doi: 10.1056/NEJMra1005073.
Lee R, et al., Epidemiology of diabetic retinopathy, diabetic macular edema and related vision loss. Eye Vis (Lond). 2015 Sep 30;2:17. doi: 10.1186/s40662-015-0026-2.



Diabetic Retinopathy

Retinal hyperglycaemia activates several metabolic pathways → converge to produce oxidative stress (ROS) and mitochondrial dysfunction, inflammation, and NADPH oxidase activation → vascular endothelial damage and retinal neurodegeneration

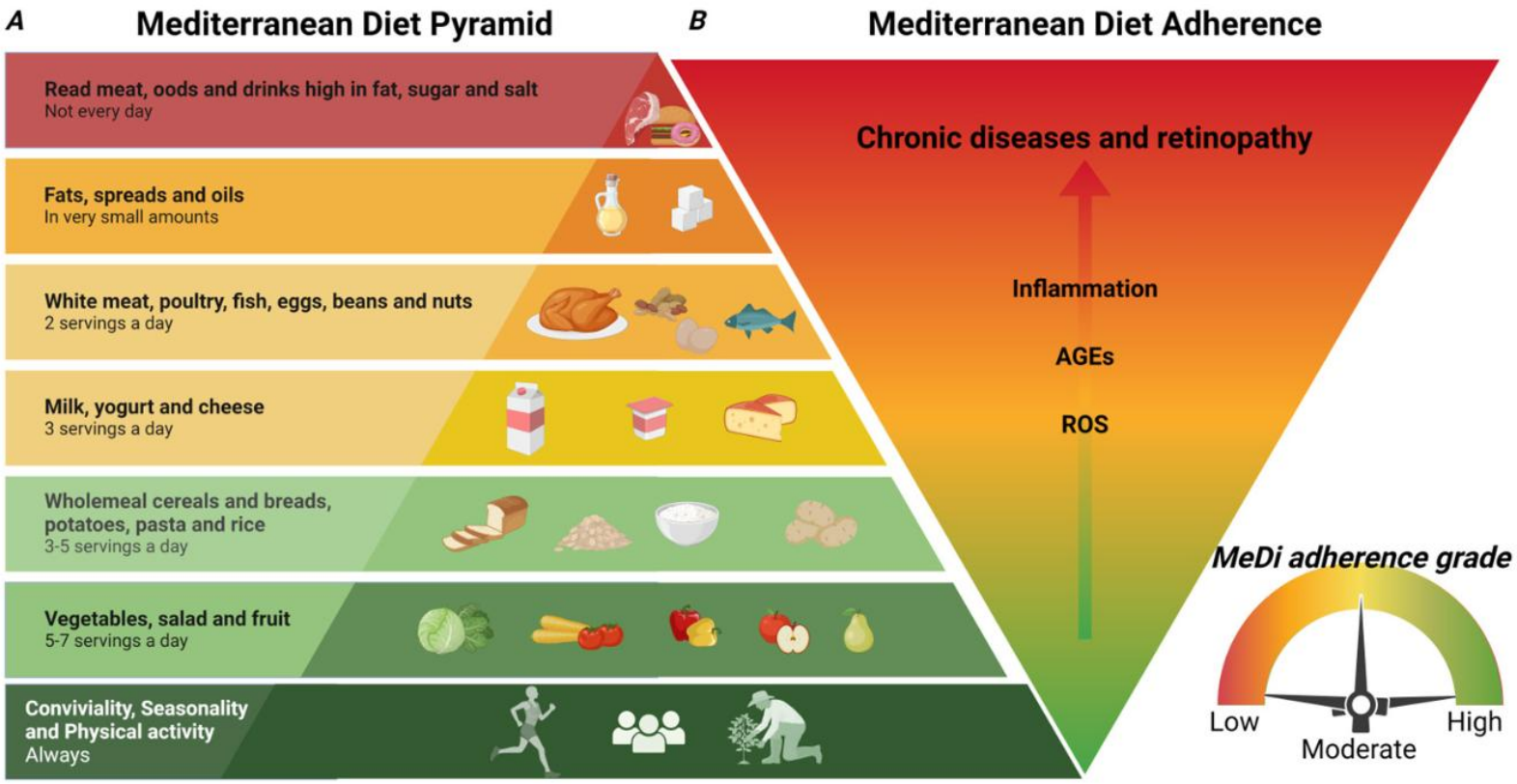
Combined effects ultimately result in **diabetic retinopathy**

Ruan Y, Jiang S, Musayeva A, Gericke A. Oxidative Stress and Vascular Dysfunction in the Retina: Therapeutic Strategies. Antioxidants (Basel). 2020 Aug 17;9(8):761. doi: 10.3390/antiox9080761.

Therapeutic Interventions

Diet, targeted nutrients and lifestyle

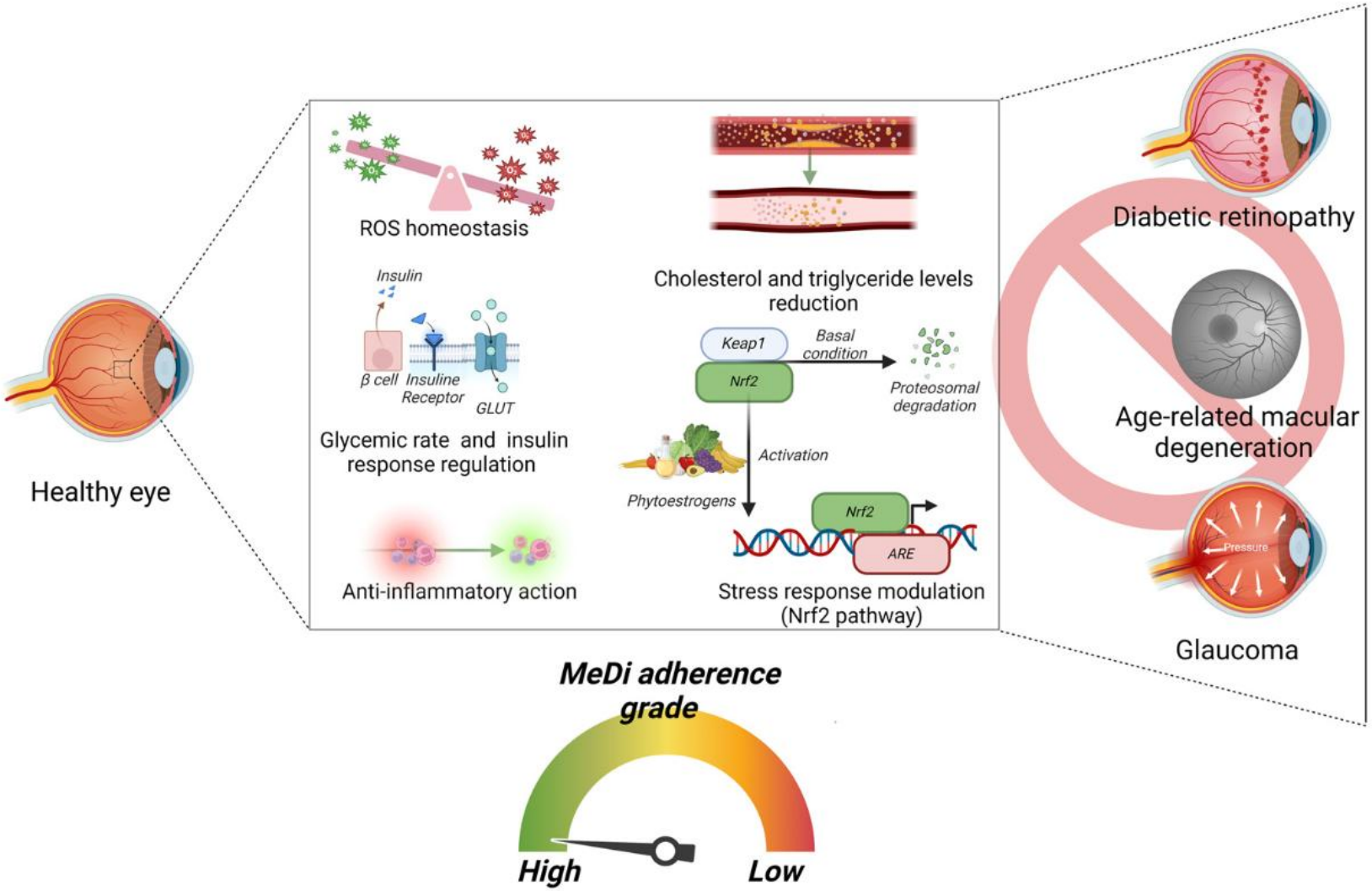
Mediterranean Diet (& lifestyle) & eyes



Not only a dietary pattern, but also sustainable food production, conviviality, and an active lifestyle, including daily social activity that promotes moderate physical activity and appropriate rest

Sbai O, et al., Effect of the Mediterranean Diet (MeDi) on the Progression of Retinal Disease: A Narrative Review. *Nutrients*. 2024; 16(18):3169. https://doi.org/10.3390/nu16183169

Mechanisms of Medi Diet adherence



Medi Diet adherence:

- Glycaemic control
- Anti-inflammatory response
- ROS homeostasis
- Cholesterol reduction
- Nrf2 activation

Sbai O, et al., Effect of the Mediterranean Diet (MeDi) on the Progression of Retinal Disease: A Narrative Review. *Nutrients*. 2024; 16(18):3169. https://doi.org/10.3390/nu16183169

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Feed the eye to heal the eye

- To maintain overall eye health, a diet rich in minerals & antioxidants
- Best sources for these are
- leafy greens, fruits, berries → colour and fibre
- Anti-inflammatory omega-3

Merra G, et al., Feed the Eye to Heal the Eye. J Curr Ophthalmol. 2024 Mar 29;35(3):209-215. doi: 10.4103/joco.joco_94_23.

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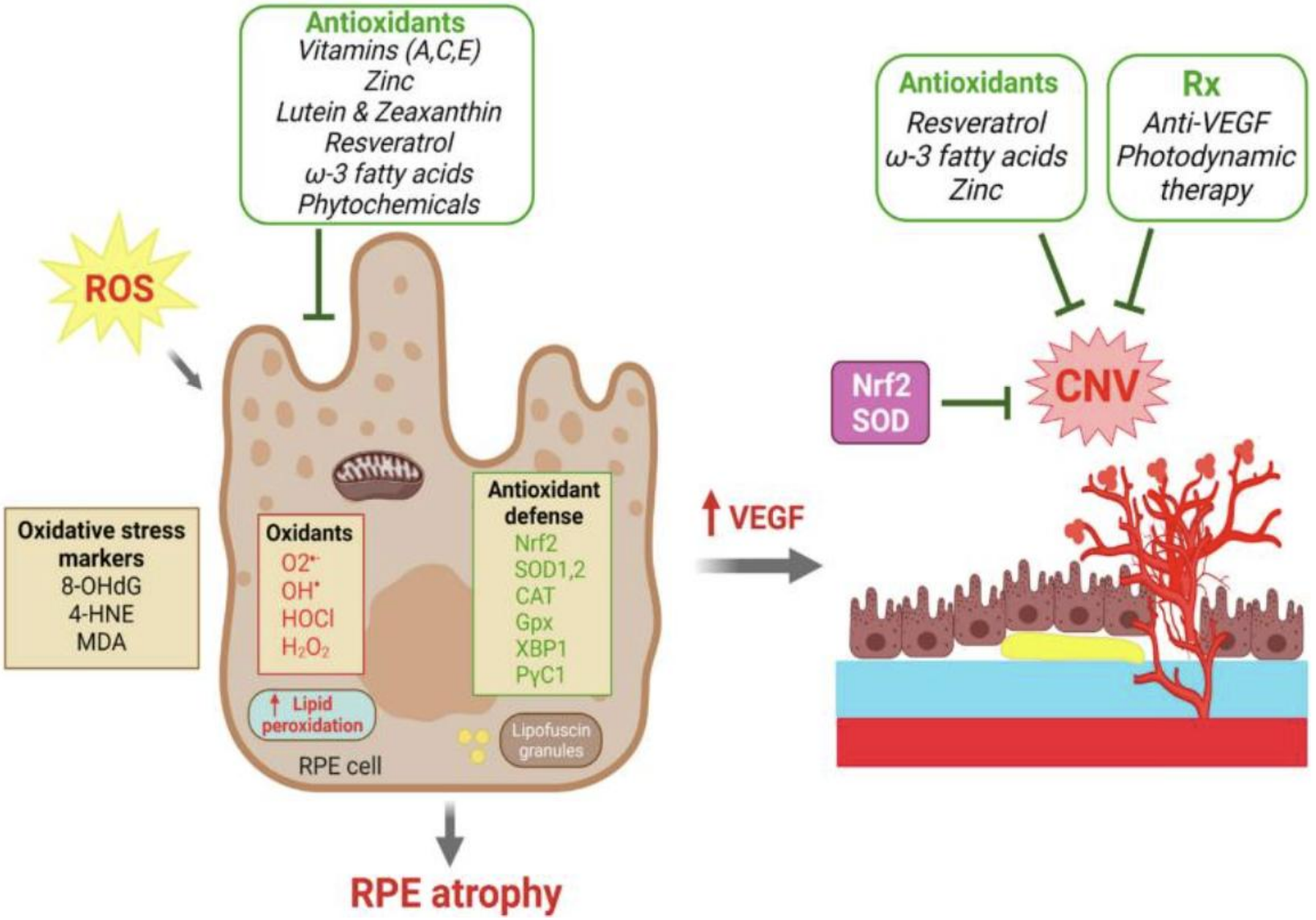
Antioxidant defence



- Excessive ROS and oxidants → oxidative damage
- Affects of ROS are countered intrinsically by antioxidant reparative defence systems with antioxidant enzymes to scavenger ROS
- CNV = choroidal neovascularization

Kushwah N, et al., Oxidative Stress and Antioxidants in Age-Related Macular Degeneration. Antioxidants (Basel). 2023 Jul 3;12(7):1379

AREDS 1 Study (1999)	The Age-Related Eye Disease Study (AREDS)
Participants	Long-term multicenter, prospective study of 4757 persons age 55 to 80 years with cataract or AMD or both
Methods	Designed to assess the clinical course, prognosis, and risk factors of both AMD and cataract Antioxidant group and zinc group Followed for 5 years
Measures	Study outcome variables are change in visual acuity and change in ocular status
Findings	Reduced risk of developing advanced AMD by 25% Reduced risk of central vision loss by 19%

Age-Related Eye Disease Study Research Group. The Age-Related Eye Disease Study (AREDS): design implications. AREDS report no. 1. Control Clin Trials. 1999 Dec;20(6):573-600. doi: 10.1016/s0197-2456(99)00031-8.

AREDS 1 Study (1999)

Participants randomly selected to receive daily oral tablets – 4 possible treatments:

- Antioxidant formulation (Vit C 500mg; Vit E 400IU; beta-carotene 15mg)
- Zinc (80mg) + copper (2mg)
- Antioxidant formulation & zinc + copper
- Placebo

Results

Reduced risk of developing advanced AMD by 25% with the combination of antioxidants and zinc + copper (final AREDS formula)

Reduced risk of central vision loss by 19%

AREDS 2 Study 2012)

AREDS 2 Study (2012)	
The Age-Related Eye Disease Study (AREDS2)	
Participants	4203 participants aged 50 to 85 with bilateral intermediate AMD or advanced AMD in 1 eye.
Methods	Multicenter, phase III, randomised, controlled clinical trial
Measures	Study outcome variables are change in visual acuity and change in ocular status
Findings	Had no additional overall effect on the risk of advanced AMD Had no overall effect on the need for cataract surgery

AREDS2 Research Group; Chew EY, et al.,The Age-Related Eye Disease Study 2 (AREDS2): study design and baseline characteristics (AREDS2 report number 1). Ophthalmology. 2012 Nov;119(11):2282-9.

Participants randomly selected to receive daily oral tablets – 4 possible treatments:

- Lutein (10 mg) + zeaxanthin (2 mg)
- Omega-3 (350 mg DHA + 650 mg EPA)
- Lutein + zeaxanthin & omega-3
- Placebo

Results

Had no additional overall effect on the risk of advanced AMD

Had no overall effect on the need for cataract surgery

AREDS Studies – Major findings

- Taking AREDS or AREDS2 supplements reduces the risk of progression from intermediate to advanced AMD by about 25 percent
- AREDS and AREDS2 supplements do not prevent AMD onset
- AREDS and AREDS2 supplements do not have an effect on cataract
- Omega-3 fatty acid supplements do not have an effect on cataract or AMD
- Current and former smokers should take the AREDS2 formula and avoid the AREDS formula with beta-carotene, which increases lung cancer risk

Vitamin A

30 patients – DED matched with 30 controls
Oral vitamin A supplement 1,500 mg for 3 days
The phenol red thread (PRT) test & assessments of tear ferning (TF), tear osmolarity, and the tear break-up time (TBUT)

Short-term oral vitamin A supplementation improves the quality, but not quantity, of tears in patients with dry eye.

Clinical Ophthalmology
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ORIGINAL RESEARCH

Effects of short-term oral vitamin A supplementation on the ocular tear film in patients with dry eye

This article was published in the following Dove Medical Press journal:
Clinical Ophthalmology

Saud A Alanazi
Gamal A El-Hiti
Abdulaziz A Al-Baloud
Mohamed I Alfarhan
Ammar Al-Shahrani
Abdulkareem A Albakri
Saad Alqahtani
Ali M Masmali

Cornea Research Chair, Department of Optometry, College of Applied Medical Sciences, King Saud University, Riyadh 11433, Saudi Arabia

Objective: To investigate the effects of short-term oral vitamin A supplementation on the ocular tear film in patients with dry eye.
Methods: In total, 30 male patients with dry eye (age range, 18–38 years, mean age, 25.2±2.8 years) who did not wear contact lenses or exhibit any ocular (other than dry eye) or systemic diseases were included, along with 30 age-matched men (control group; mean age, 24.5±2.3 years) with healthy eyes. Subject exclusion was based on the findings of the McMonnies questionnaire (cutoff score for dry eye: 14.5) and slit-lamp biomicroscopy. All subjects received an oral vitamin A supplement at a daily dose of 1,500 mg for 3 consecutive days. The phenol red thread (PRT) test was performed along with assessments of tear ferning (TF), tear osmolarity, and the tear break-up time (TBUT) before and 24 hours after the third dose of the vitamin A supplement. A 10-minute interval was observed between different tests.
Results: In the dry eye group, the TF grade (Wilcoxon test, $P=0.01$) exhibited a significant decrease, while the tear osmolarity value (t-test, $P=0.01$) exhibited a significant increase after vitamin A supplementation. The PRT test findings ($P=0.17$) and TBUT ($P=0.49$) showed no significant differences before and after vitamin A supplementation. In the control group, vitamin A supplementation showed no significant effects on TF ($P=0.74$), tear osmolarity ($P=0.55$), the TBUT ($P=0.19$), and the PRT test scores ($P=0.48$).
Conclusion: Our findings suggest that short-term oral vitamin A supplementation improves the quality, but not quantity, of tears in patients with dry eye. Future studies should involve larger patient samples and longer periods of vitamin A supplementation.
Keywords: vitamin A supplement, dry eye, tear film, tear ferning, phenol red thread test, tear break-up time, tear osmolarity

Introduction

Vitamin A is a mixture of retinol, retinal, and retinoic acid (Figure 1) along with other components such as β-carotene.[1] The most common animal sources for vitamin A are cod liver oil, liver, butter, cheese, eggs, and fish, whereas the most common vegetable sources include sweet potato, carrot, broccoli, sweet red pepper, spinach, and lettuce. Retinol and carotene are the most common forms of vitamin A in food.[2] Vitamin A is essential for good vision, growth, reproduction, bone metabolism, gene transcription, and immune health.[3] Moreover, vitamin A in the form of retinal combines with opsin to produce rhodopsin in the retina, which is important for both color and scotopic (low-light) vision.[4]

Vitamin A deficiency is very common in children aged <5 years. It affects around a third of the pediatric population worldwide and causes blindness in 250,000–500,000 children in developing countries each year.[5,6] A previous study found that a diet containing low levels of vitamin A was found to be the main cause for night blindness

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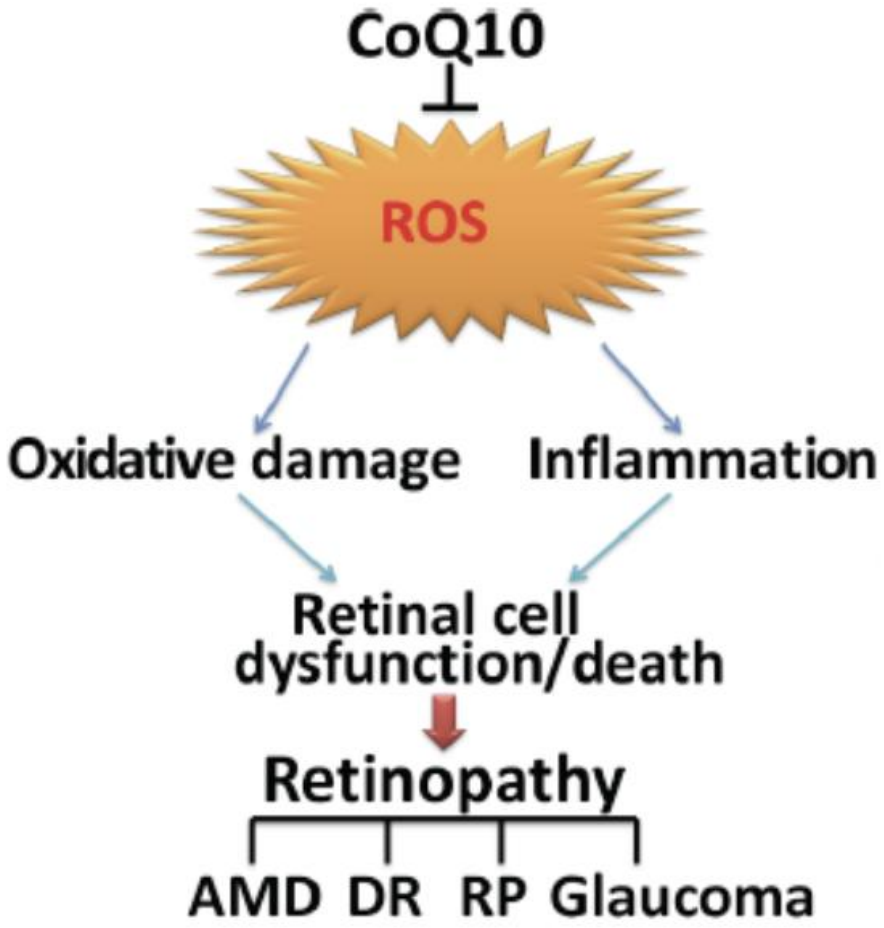
Email saaalanazi@ksu.edu.sa; gelhiti@ksu.edu.sa

Alanazi SA, et al., Effects of short-term oral vitamin A supplementation on the ocular tear film in patients with dry eye. Clin Ophthalmol. 2019 Apr 10;13:599-604. doi: 10.2147/OPTH.S198349.

CoQ10 and eye health

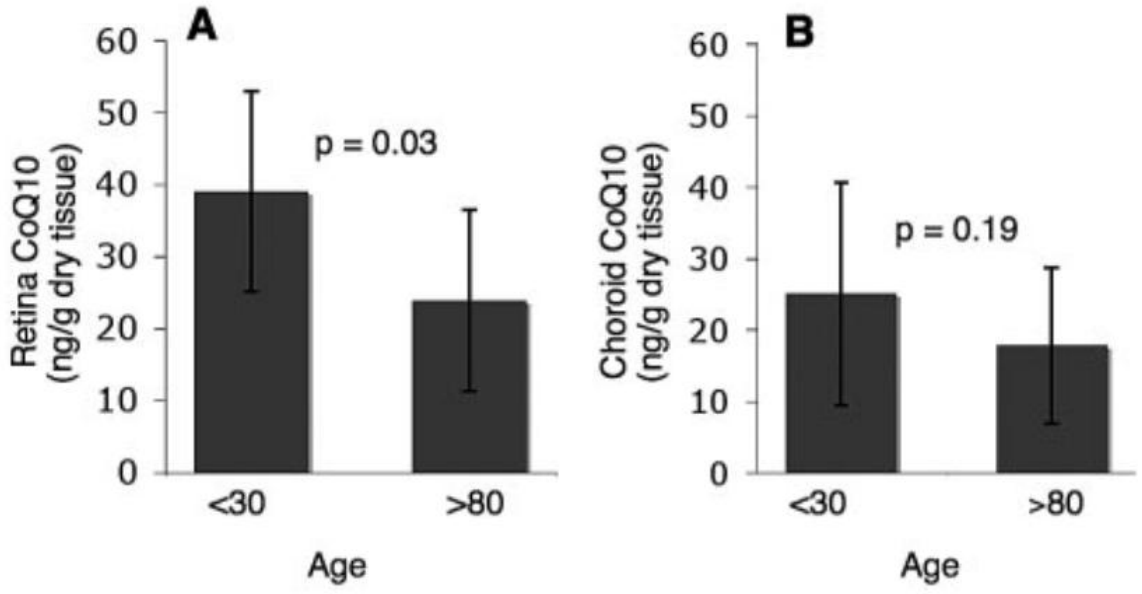


- Protective mechanism of CoQ10 *via* inhibiting ROS production →
- Subsequently attenuates oxidative damage and inflammation → reduce death of retinal cells (photoreceptors, retinal pigment epithelium cellsand ganglion cells) → delays the progression of retinal diseases

Zhang X, et al., Therapeutic Potential of Co-enzyme Q10 in Retinal Diseases. Curr Med Chem. 2017;24(39):4329-4339.

CoQ10 in the human retina

- In the retina, levels of CoQ10 also declines with age (by approximately 40%)
- Two consequences:
  - Decrease in antioxidant ability
  - Decrease in ATP synthesis
- Both exacerbate the risk of retinal disease and macular degeneration
- The relative concentration of CoQ10, with its ability to act as an efficient antioxidant, → CoQ10 may function as a powerful antioxidant in the eye



Qu J, Kaufman Y, Washington I. Coenzyme Q10 in the human retina. Invest Ophthalmol Vis Sci. 2009 Apr;50(4):1814-8. doi: 10.1167/iovs.08-2656. Epub 2008 Dec 5.

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Coenzyme Q10

- Used in 100+ clinical trials, 30+ years
- Reference product of the International Coenzyme Q10 Association
- Documented bioavailability, proven in human clinical trials
- Manufactured under pharmaceutical control

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Mitochondrial support

DBRCT; 106 patients – 55-70 yrs old; diagnosis of early bilateral AMD

Treatment group: Capsule containing 100 mg of Acetyl-L-Carnitine, 230mg EPA+160mg DHA, 10 mg of CoQ10 - taken 2 x daily

Placebo: Soy oil

After 12 months of supplementation in patients with early AMD:

- Improvement in visual field mean defect
- Better visual acuity and foveal sensitivity
- Reduction in drusen-covered area in treated eyes vs placebo

These findings strongly suggest an appropriate combination of compounds which affect mitochondrial lipid metabolism, may improve and stabilise visual functions and also improve fundus alterations in early AMD patients

Feher J, et al., Improvement of visual functions and fundus alterations in early age-related macular degeneration treated with a combination of acetyl-L-carnitine, n-3 fatty acids, and coenzyme Q10. Ophthalmologica. 2005 May-Jun;219(3):154-66.

Omega fatty acids and DED

- RCT – 3 months; 50 participants
- Determine the effect of daily intake EFAs on signs and symptoms of DED
- Treatment group (24): 1200mg EPA; 300mg DHA, 150mg GLA
- Placebo (26) : Coconut and olive oil
- **Assessments**:
  - Ocular Surface Disease Index (OSDI) questionnaire; Symptom Assessment Questionnaire in Dry Eye, non-invasive tear breakup time, tear meniscus height, tear osmolarity, ocular redness, surface staining, Schirmer test, and meibography
- Results:
  - **Significant and clinically meaningful improvement** of dry eye symptoms in extremely symptomatic participants with DED

Ng A, et al., J. Effect of a Novel Omega-3 and Omega-6 Fatty Acid Supplement on Dry Eye Disease: A 3-month Randomized Controlled Trial. Optom Vis Sci. 2022 Jan 1;99(1):67-75.

Omegas and DES

Systematic Review (2017)

“ Intensive screen device users and contact lens wearers are the population groups that experience the clearer benefits of omega-3/omega-6 supplementation.”

Acta Ophthalmologica

Acta Ophthalmologica 2017

Efficacy of nutritional supplementation with omega-3 and omega-6 fatty acids in dry eye syndrome: a systematic review of randomized clinical trials

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[3]Department of Dermatology, Torrecárdenas Hospital Complex, Almería, Spain

ABSTRACT.

Purpose: **To critically appraise scientific evidence regarding the efficacy of nutritional supplementation with omega-3 and omega-6 fatty acids for the treatment of dry eye syndrome (DES).**

Methods: **A systematic review of randomized clinical trials was performed. Two independent reviewers selected and analysed the scientific papers that met inclusion and exclusion criteria. Objective and subjective efficacy outcomes were assessed.**

Results: **The trials involved a total of 2591 patients in fifteen independent studies. All studies were published between 2005 and 2015. The supplements used were mostly omega-3 and omega-6 in different proportions. Subjective improvement was measured using mainly Ocular Surface Disease Index (OSDI) test and Dry Eye Severity Score (DESS) test: significant differences in favour of the experimental group were found in seven of the studies. The objective amelioration was assessed by lacrimal function parameters: Tear break-up time (TBUT) significantly increased in nine studies and Schirmer's test in four studies.**

Conclusion: **We observed a discrete improvement in the parameters of tear function. Scientific evidence is not strong enough to systematically recommend the use of omega-3 and omega-6 fatty acids as a standalone treatment of DES independently from its aetiology. However, they could be considered as an effective alternative to topical treatment in patients with DES secondary to certain pathologies.**

Key words: clinical trials – dry eye – omega fatty acids – oral supplementation – systematic review

Acta Ophthalmol 2017: 95: e677–e685

doi: 10.1111/aos.13428

Introduction

Dry eye syndrome (DES) is a common pathology with an estimated prevalence of 10–30% of the population (Vehof et al. 2014; Li et al. 2015). Classically, DES was linked to ageing, but with modern lifestyles which include the intensive use of backlit screens such as computer displays or smartphones, the use of contact lenses and corneal refractive surgery, its incidence among young subjects has increased (Ong et al. 2013; Ahn et al. 2014; Tauste et al. 2014). The most common symptoms of DES are eye redness, dryness, gritty sensation, burning, pain, ocular fatigue and blurry vision. These produce a significant impairment of quality of life (Paulsen et al. 2014).

Typically, the therapeutic approach of DES is based on topical measures. The instillation of artificial teardrops is the most frequently used treatment. However, patients do not always accept and comply with topical treatment. Some refuse to self-apply topical measures to their eyes, while others feel uncomfortable instilling eye drops several times a day.

In recent years, an increasing number of nutritional supplements containing omega-3 and omega-6 fatty acids aiming to improve DES symptoms have been developed. Essential fatty acids are necessary to maintain good health and cannot be synthesized by human beings. The most important polyunsaturated fatty acids are omega-3 (n-3 PUFA) and omega-6 (n-6 PUFA), which play an important role in regulating the inflammatory and immune response.

Arachidonic acid (AA) is an n-6 metabolite and the precursor of prostaglandins, leukotrienes and other immune molecules. The n-3 PUFA metabolites, docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), compete with AA to incorporate in cellular membrane phospholipids (Calder & Grimble 2002). Fish

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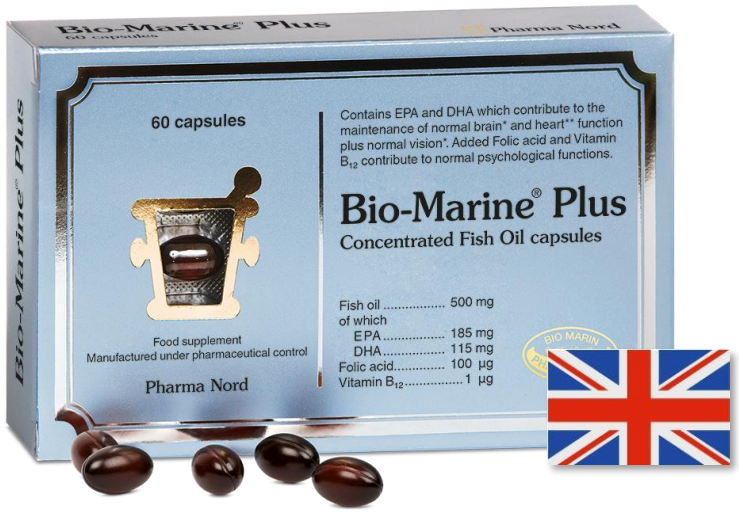
- **Free fatty acid form** x1.6 better absorption than triglyceride form
- Small and easy to swallow source of DHA & EPA
- Screened for heavy metal content
- Featured in human clinical trials
- Suitable for ages 11+



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Oral Sea Buckthorn Oil & DED

DBRCT 86 participants

2 g of SB or placebo oil daily for 3 months

Tear film hyperosmolarity is a focal factor in dry eye

The increase in osmolarity from baseline to the end of the intervention was significantly less in the SB group
The maximum intensities of redness and burning tended to be lower in the SB group

Conclusion:

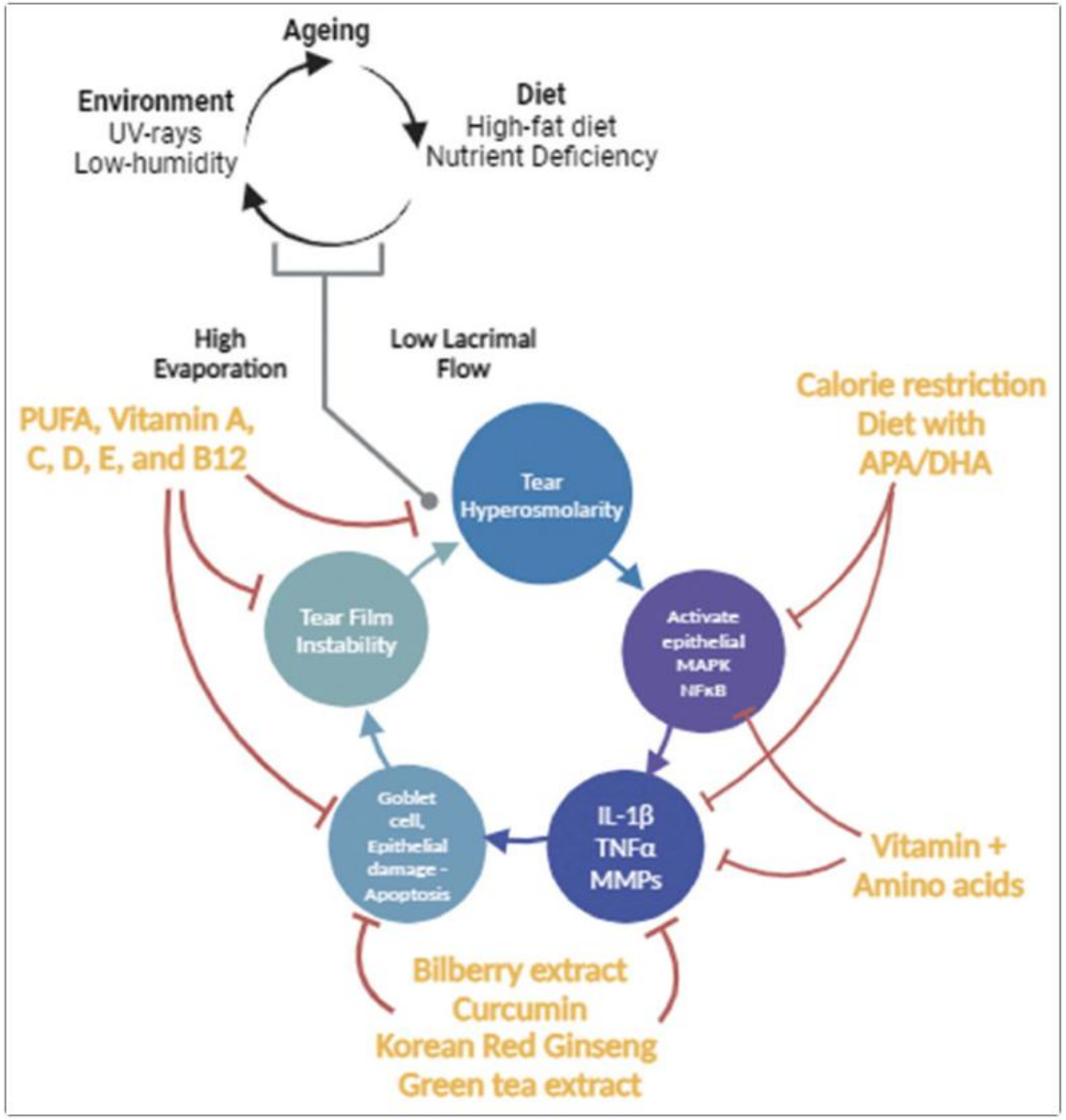
SB oil attenuated the increase in tear film osmolarity during the cold season and positively affected the dry eye symptoms.

Found to reduce symptoms of dry eyes

Iarmo P et al (2010). Oral Sea Buckthorn Oil Attenuates Tear Film Osmolarity and Symptoms in Individuals with Dry Eye. The Journal Of Nutrition

Sea buckthorn oil
BioActive Omega-7 SBA24

- Unique SBA24 formulation, extracted from berry and seeds
- SBA24 is the dominant formula in research
- Contains Omega 7, 3, 6 and 9
- Super critical CO2 extraction



Dry Eyes

- Self-perpetuating cycle of dry eye diseases and it's management through dietary components
- Healthy fats, antioxidants, amino acids (protein), polyphenols

Bhandarkar NS, Shetty K, Narendra P, Kiran A, Shetty R, Shetty KB. Nutrition and diet for dry eye disease: Insights toward holistic management. Indian J Ophthalmol. 2024 Oct 1;72(10):1412-1423. doi: 10.4103/IJO.IJO_2899_22.

Curcumin and eye health

- Curcumin supports ocular health primarily through anti-inflammatory, antioxidant, anti-angiogenic, cytoprotective, and neuroprotective mechanisms - targeting the core biochemical drivers of eye disease
- Curcumin acts as a multi-target ocular therapeutic, influencing several pathological pathways simultaneously:

Primary targets include:

- Oxidative stress
- Inflammatory signalling (NF-κB, MAPK)
- Angiogenesis (VEGF)
- Cellular proliferation
- Protein aggregation
- Calcium dysregulation
- Neurodegeneration

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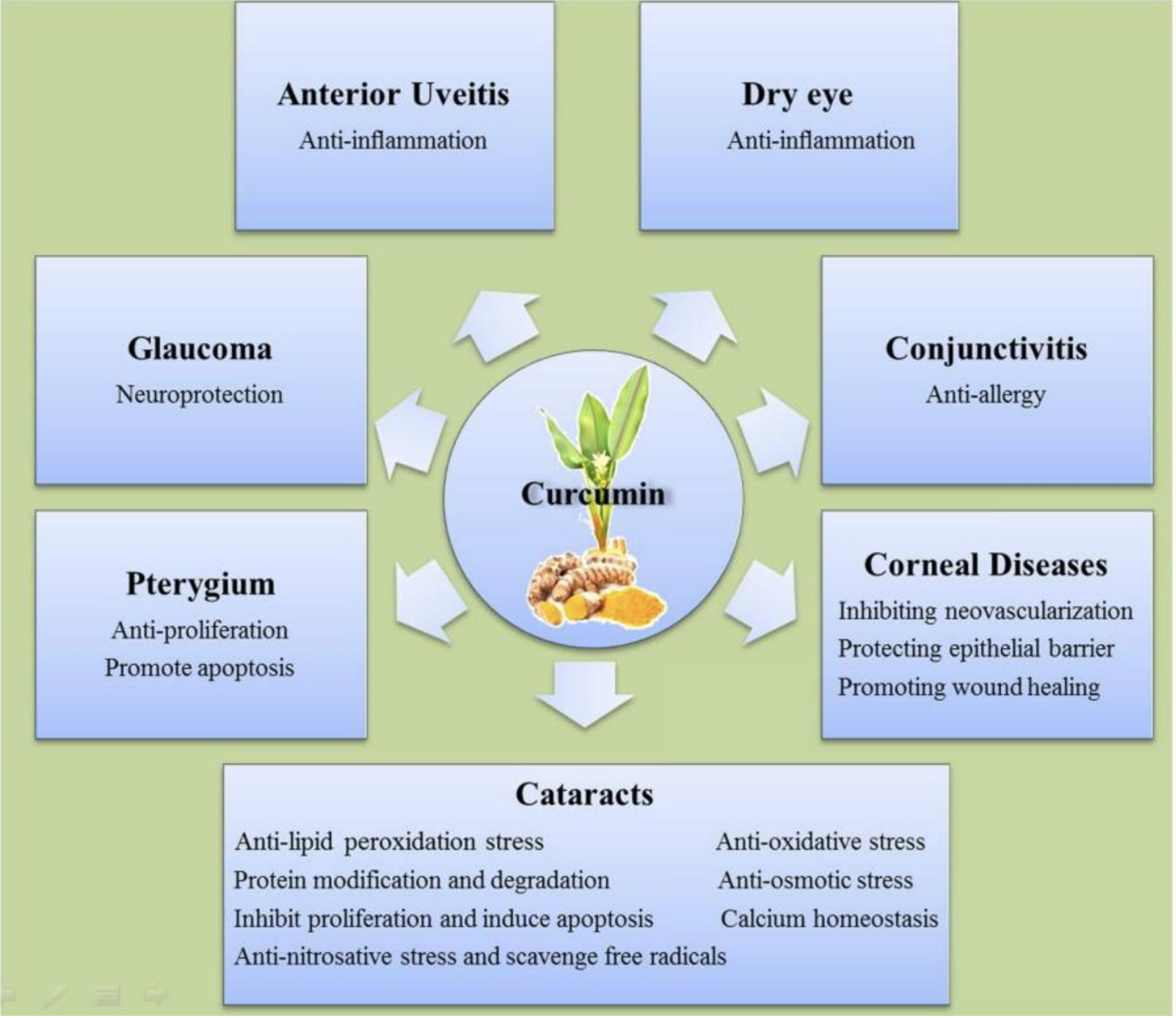
Liu XF, et al., Curcumin, A Potential Therapeutic Candidate for Anterior Segment Eye Diseases: A Review. Front Pharmacol. 2017 Feb 14;8:66. doi: 10.3389/fphar.2017.00066.



Curcumin

The mechanisms of the beneficial effects of curcumin on different anterior segment eye diseases.

Liu XF, et al., Curcumin, A Potential Therapeutic Candidate for Anterior Segment Eye Diseases: A Review. Front Pharmacol. 2017 Feb 14;8:66. doi: 10.3389/fphar.2017.00066.

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Curcumin

- Featured in extract-specific research, including bioavailability, joint health and cognition
- Patented Solid Lipid Curcumin Particle (SLCP) delivery form
- Documented high bioavailability
- Protected from glucuronidation

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Pycnogenol improves diabetic retinopathy

Pycnogenol improves microcirculation, retinal oedema, and visual acuity in early diabetic retinopathy	
Participants	46 patients – T2DM; moderate degree of diabetic retinopathy
Methods	50mg Pynogenol 3 x day (150mg daily) for 2 months Placebo group
Measures	Patient's visual acuity was assessed; evaluation of diabetic retinopathy; retinal blood flow and retinal thickness
Findings	Treatment significantly improved retinal blood flow, expressed as flow velocity at the central retinal artery and visual improvement

Steigerwalt R, et al.,Pycnogenol improves microcirculation, retinal edema, and visual acuity in early diabetic retinopathy. J Ocul Pharmacol Ther. 2009 Dec;25(6):537-40. doi: 10.1089/jop.2009.0023.

Our study suggests that Pycnogenol may be especially beneficial for diabetic patients during early stages of retinopathy for stopping progression of the disease and restoring vision lost to this time.

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Pycnogenol

A research-driven & sustainable pine bark extract

- 40mg of Pycnogenol per tablet
- Consistent levels of plant compounds from batch to batch
- Over 40 years of research in various areas of health
- Suitable for vegetarians and vegans

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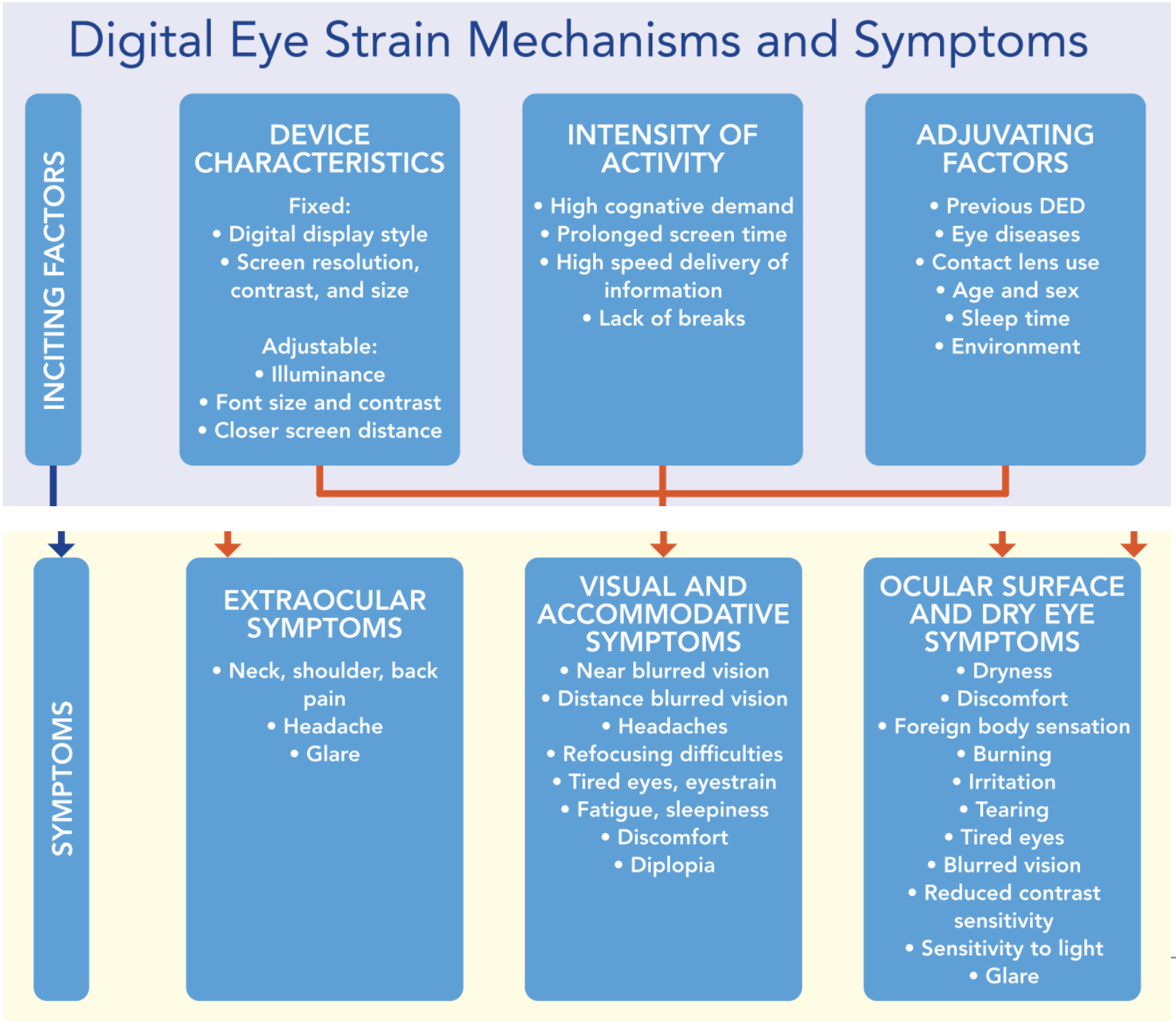
Lifestyle Interventions - Smoking

- Increased risk of AMD of 2-3-fold in current-smokers compared with never-smokers
- When the length and duration of smoking were combined as pack-years there was an increasing risk of AMD as the number of pack-years increased from 0.25 to >40
- Ex-smokers still had an increased risk of developing AMD compared with never-smokers but it was considerably lower than in current-smokers

Mechanisms:

- Accumulated oxidative damage in the retina
- Reduced choroidal blood flow in the eye
- Promotes ischaemia, hypoxia, and micro-infarctions, all increase the susceptibility of the macula to degenerative changes

Thornton, J., *et al.* Smoking and age-related macular degeneration: a review of association. *Eye* **19**, 935–944 (2005). https://doi.org/10.1038/sj.eye.6701978



Digital Eye Strain

Defined as “the development or exacerbation of recurrent ocular symptoms and/or signs related specifically to digital device screen viewing”

Wolffsohn JS, et al., TFOS Lifestyle: Impact of the digital environment on the ocular surface. Ocul Surf. 2023 Apr;28:213-252. doi: 10.1016/j.jtos.2023.04.004.

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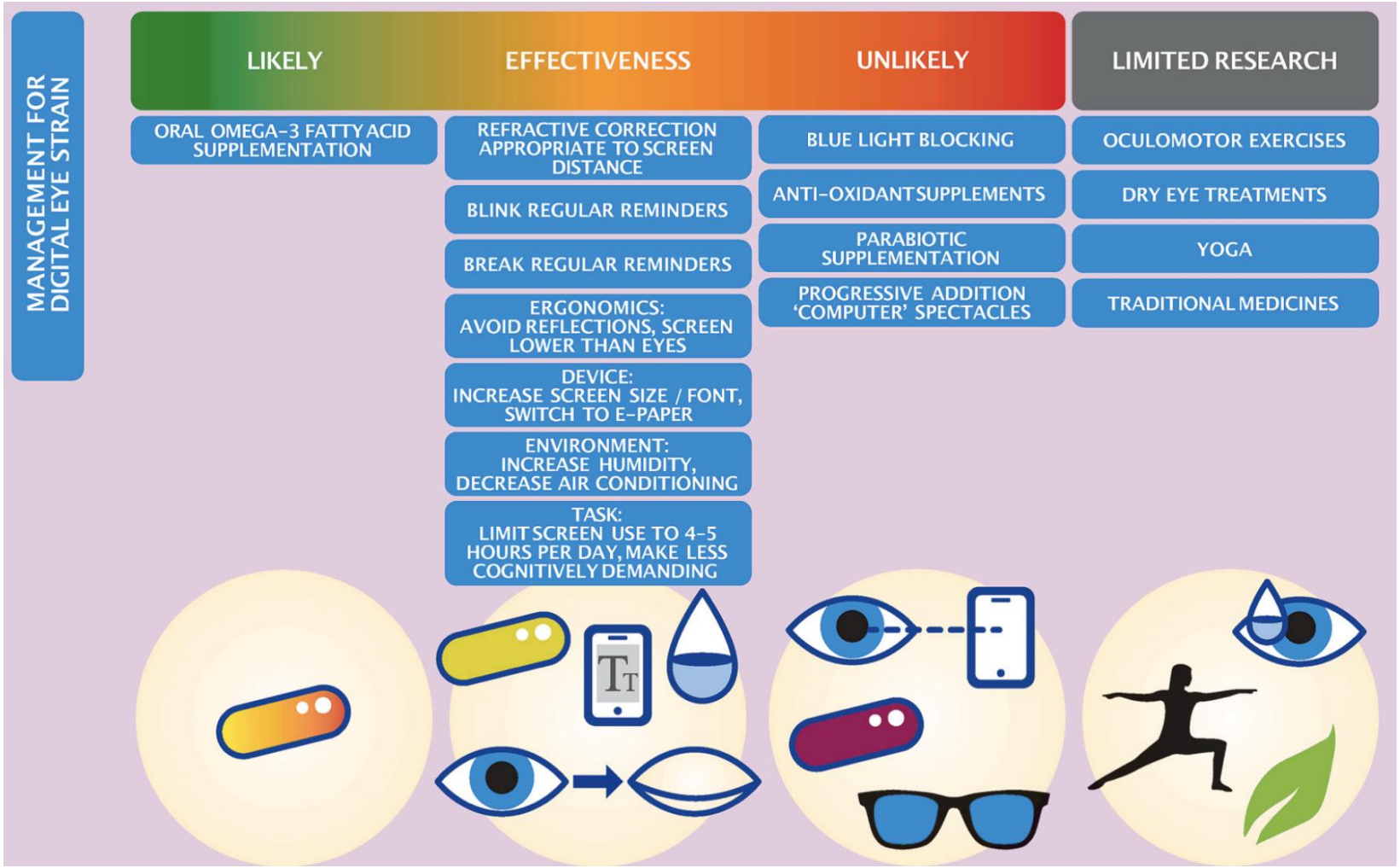
Digital Eye Strain



20/20/20 rule:

Take a 20-s break every 20 min and focus on an object at least 20 feet away

Keep blinking:

10-s cycle of blinking exercises every 20 min during waking hours

Wolffsohn JS, et al., TFOS Lifestyle: Impact of the digital environment on the ocular surface. Ocul Surf. 2023 Apr;28:213-252. doi: 10.1016/j.jtos.2023.04.004.

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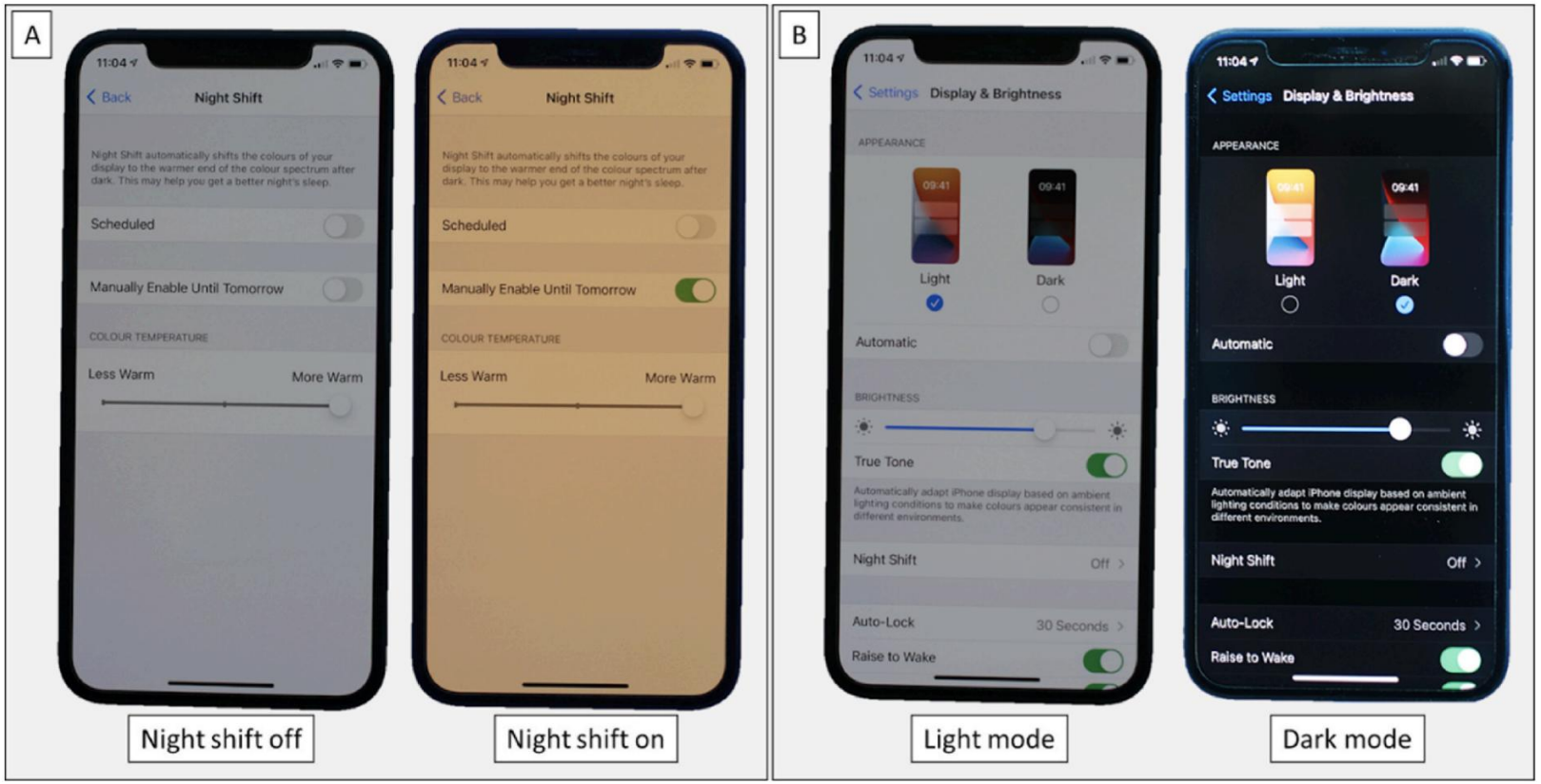
Digital Eye Strain



Blue light exposure can suppress the production/release of melatonin

And has been found to shift circadian rhythm by twice as much as green light

Wolffsohn JS, et al., TFOS Lifestyle: Impact of the digital environment on the ocular surface. Ocul Surf. 2023 Apr;28:213-252. doi: 10.1016/j.jtos.2023.04.004.

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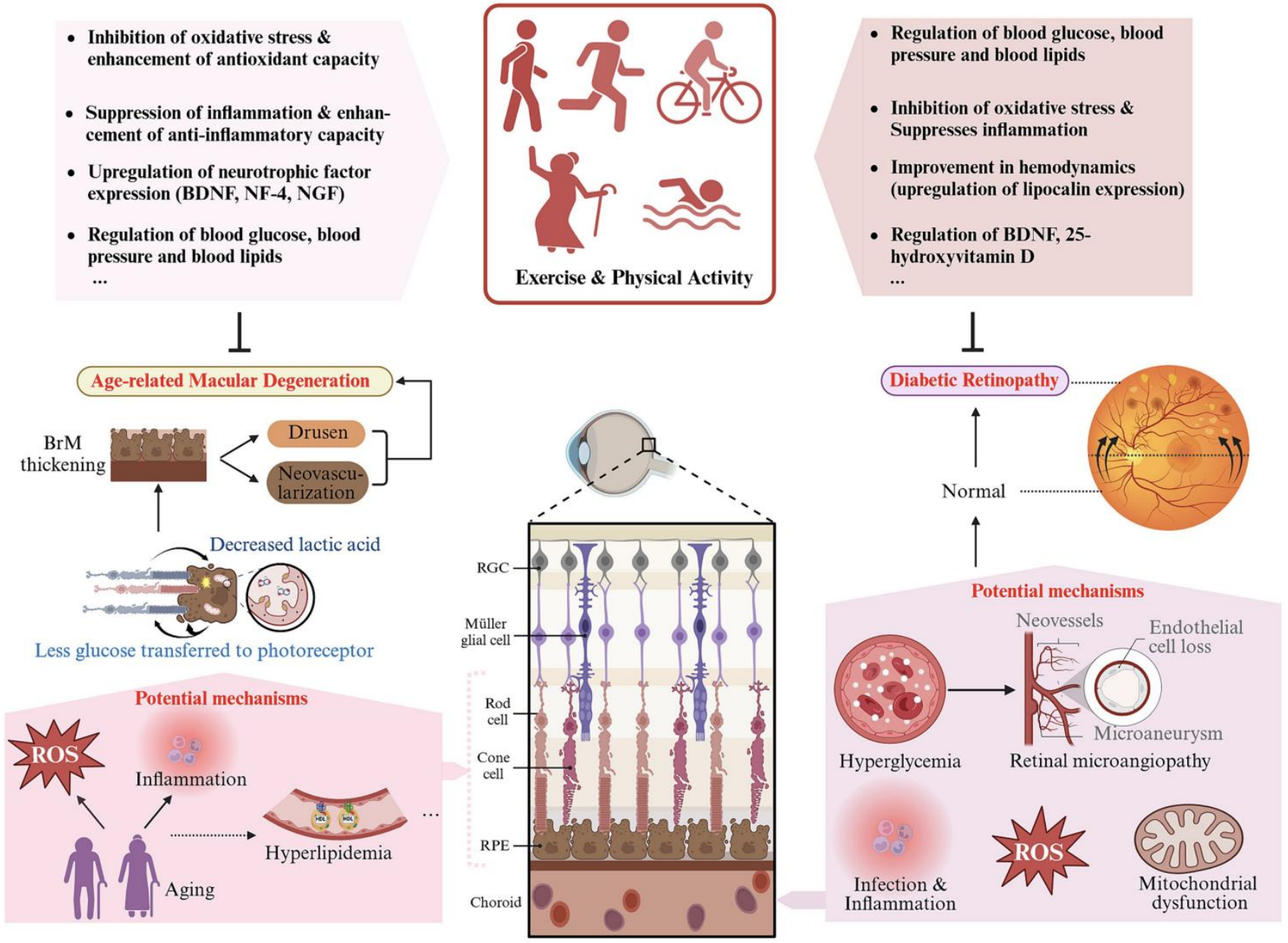

Exercise & Eye health

- Mitigates ocular oxidative stress & inflammation Reduces intraocular pressure
- Enhances mitochondrial function
- Promotes ocular blood circulation and release of protective factors

Zhang Q, et al., Effects and potential mechanisms of exercise and physical activity on eye health and ocular diseases. Front Med (Lausanne). 2024 Mar 22;11:1353624.

doi: 10.3389/fmed.2024.1353624.

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Summary

1. Mediterranean-style dietary pattern – nutrient dense; fibre
2. Omega 3,7 fatty acids and optimal anti-oxidants
3. Smoking cessation support as necessary
4. Manage screen time – light intensity and take breaks
5. Keep moving

Q&A Panel Webinar

Adrenal and Thyroid Health

With Lorraine Nicolle, Sue Camp & Helen Lynam

- Tuesday **14th April 2026**
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- Various dates from April 16th - July 7th
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Thank you!

Please email

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For any queries!

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References

- Age-Related Eye Disease Study Research Group. The Age-Related Eye Disease Study (AREDS): design implications. AREDS report no. 1. Control Clin Trials. 1999 Dec;20(6):573-600. doi: 10.1016/s0197-2456(99)00031-8.
- Alanazi SA, et al., Effects of short-term oral vitamin A supplementation on the ocular tear film in patients with dry eye. Clin Ophthalmol. 2019 Apr 10;13:599-604. doi: 10.2147/OPTH.S198349.
- Antonetti DA, Klein R, Gardner TW. Diabetic retinopathy. N Engl J Med. 2012 Mar 29;366(13):1227-39. doi: 10.1056/NEJMra1005073.
- Lee R, et al., Epidemiology of diabetic retinopathy, diabetic macular edema and related vision loss. Eye Vis (Lond). 2015 Sep 30;2:17. doi: 10.1186/s40662-015-0026-2.
- AREDS2 Research Group; Chew EY, et al.,The Age-Related Eye Disease Study 2 (AREDS2): study design and baseline characteristics (AREDS2 report number 1). Ophthalmology. 2012 Nov;119(11):2282-9.
- Bhandarkar NS, et al., Nutrition and diet for dry eye disease: Insights toward holistic management. Indian J Ophthalmol. 2024 Oct 1;72(10):1412-1423. doi: 10.4103/IJO.IJO_2899_22.
- Burton MJ, et el., The Lancet Global Health Commission on Global Eye Health: vision beyond 2020. Lancet Glob Health. 2021 Apr;9(4):e489-e551. doi: 10.1016/S2214-109X(20)30488-5. Epub 2021 Feb 16.
- Chen X, Hong J, Le Q. Role of mitochondrial dysfunction in ocular surface diseases. Cell Stress. 2025 Aug 5;9:174-181. doi: 10.15698/cst2025.08.309.
- Feher J, et al., Improvement of visual functions and fundus alterations in early age-related macular degeneration treated with a combination of acetyl-L-carnitine, n-3 fatty acids, and coenzyme Q10. Ophthalmologica. 2005 May-Jun;219(3):154-66.
- Fleckenstein, M., Keenan, T.D.L., Guymer, R.H. et al. Age-related macular degeneration. Nat Rev Dis Primers 7, 31 (2021). https://doi.org/10.1038/s41572-021-00265-2
- Huang R, et al., Dry eye syndrome: comprehensive etiologies and recent clinical trials. Int Ophthalmol. 2022 Oct;42(10):3253-3272. doi: 10.1007/s10792-022-02320-7.
- Hussey KA, Hadyniak SE, Johnston RJ Jr. Patterning and Development of Photoreceptors in the Human Retina. Front Cell Dev Biol. 2022 Apr 14;10:878350. doi: 10.3389/fcell.2022.878350.
- Iarmo P et al (2010). Oral Sea Buckthorn Oil Attenuates Tear Film Osmolarity and Symptoms in Individuals with Dry Eye. The Journal Of Nutrition
- Joyal JS, Gantner ML, Smith LEH. Retinal energy demands control vascular supply of the retina in development and disease: The role of neuronal lipid and glucose metabolism. Prog Retin Eye Res. 2018 May;64:131-156. doi: 10.1016/j.preteyeres.2017.11.002.
- Kang Q, Yang C. Oxidative stress and diabetic retinopathy: Molecular mechanisms, pathogenetic role and therapeutic implications. Redox Biol. 2020 Oct;37:101799. doi: 10.1016/j.redox.2020.101799.
- Kushwah N, et al., Oxidative Stress and Antioxidants in Age-Related Macular Degeneration. Antioxidants (Basel). 2023 Jul 3;12(7):1379
- Liu XF, et al., Curcumin, A Potential Therapeutic Candidate for Anterior Segment Eye Diseases: A Review. Front Pharmacol. 2017 Feb 14;8:66. doi: 10.3389/fphar.2017.00066.
- Merra G, et al., Feed the Eye to Heal the Eye. J Curr Ophthalmol. 2024 Mar 29;35(3):209-215. doi: 10.4103/joco.joco_94_23.
- Mitchell P et al., Age-related macular degeneration. Lancet. 2018 Sep 29;392(10153):1147-1159. doi: 10.1016/S0140-6736(18)31550-2.
- Molina-Leyva, I. et al., (2017), Efficacy of nutritional supplementation with omega-3 and omega-6 fatty acids in dry eye syndrome: a systematic review of randomized clinical trials. Acta Ophthalmol, 95: e677-e685. https://doi.org/10.1111/aos.13428
- Ng A, et al., Effect of a Novel Omega-3 and Omega-6 Fatty Acid Supplement on Dry Eye Disease: A 3-month Randomized Controlled Trial. Optom Vis Sci. 2022 Jan 1;99(1):67-75.
- Qian L, Wei W. Identified risk factors for dry eye syndrome: A systematic review and meta-analysis. PLoS One. 2022 Aug 19;17(8):e0271267. doi: 10.1371/journal.pone.0271267.
- Qu J, Kaufman Y, Washington I. Coenzyme Q10 in the human retina. Invest Ophthalmol Vis Sci. 2009 Apr;50(4):1814-8. doi: 10.1167/iovs.08-2656. Epub 2008 Dec 5.
- Ruan Y, Jiang S, Musayeva A, Gericke A. Oxidative Stress and Vascular Dysfunction in the Retina: Therapeutic Strategies. Antioxidants (Basel). 2020 Aug 17;9(8):761. doi: 10.3390/antiox9080761.
- Sbai O, et al., Effect of the Mediterranean Diet (MeDi) on the Progression of Retinal Disease: A Narrative Review. Nutrients. 2024; 16(18):3169. https://doi.org/10.3390/nu16183169
- Singh C. Metabolism and Vascular Retinopathies: Current Perspectives and Future Directions. Diagnostics (Basel). 2022 Apr 5;12(4):903. doi: 10.3390/diagnostics12040903.
- Srejovic JV, et al. Molecular and Cellular Mechanisms Involved in the Pathophysiology of Retinal Vascular Disease—Interplay Between Inflammation and Oxidative Stress. International Journal of Molecular Sciences. 2024; 25(21):11850. https://doi.org/10.3390/ijms252111850
- Stapleton F et al., TFOS DEWS II Epidemiology Report. Ocul Surf. 2017 Jul;15(3):334-365. doi: 10.1016/j.jtos.2017.05.003
- Steigerwalt R, et al.,Pycnogenol improves microcirculation, retinal edema, and visual acuity in early diabetic retinopathy. J Ocul Pharmacol Ther. 2009 Dec;25(6):537-40. doi: 10.1089/jop.2009.0023

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References

- Sun H, et al., Imbalanced mitochondrial homeostasis in ocular diseases: unique pathogenesis and targeted therapy. Exp Eye Res. 2025 Nov;260:110632. doi: 10.1016/j.exer.2025.110632.
- Thornton, J., et al. Smoking and age-related macular degeneration: a review of association. Eye 19, 935–944 (2005). https://doi.org/10.1038/sj.eye.6701978
- Wolffsohn JS, et al., TFOS Lifestyle: Impact of the digital environment on the ocular surface. Ocul Surf. 2023 Apr;28:213-252. doi: 10.1016/j.jtos.2023.04.004.
- Wu KY, et al., Cell Therapy for Retinal Degenerative Diseases: Progress and Prospects. Pharmaceutics. 2024 Oct 5;16(10):1299. doi: 10.3390/pharmaceutics16101299.
- Zhang Q, et al., Effects and potential mechanisms of exercise and physical activity on eye health and ocular diseases. Front Med (Lausanne). 2024 Mar 22;11:1353624. doi: 10.3389/fmed.2024.1353624.
- Zhang X, et al., Therapeutic Potential of Co-enzyme Q10 in Retinal Diseases. Curr Med Chem. 2017;24(39):4329-4339.