NeuroRays • Selected supportive studies across five research questions • 18 November 2026

1 Retinal retinoic acid is higher in dim light

Mar 2025 · Talwar et al. · Investigative Ophthalmology & Visual Science (IOVS) 66(3), 37

Modulation of All-Trans Retinoic Acid by Light and Dopamine in the Murine Eye

After dark adaptation, mice received 1, 59 or 12,000 lux. At every matched time point, retinal all-trans retinoic acid (atRA) was significantly higher under dim light than under bright light. At 60 minutes, the mean concentration was 32% higher under dim light. The finding concerns the difference between lighting conditions at the same time after exposure began.

Exposure time	Dim (1 lux)	Bright (12,000 lux)	Dim vs bright
5 minutes	54.32	46.23	18% higher
15 minutes	51.12	41.74	22% higher
60 minutes	43.50	32.89	32% higher

Mean retinal atRA in pmol/g. Percentages use the bright-light group as the denominator. Talwar et al., Figure 3A.

July 2025 · Li Linfang et al. · Journal of Hainan Medical University 31(13), 961–969

Effects of the Rizhong dietary formula on eye development, retinal RA and DA levels, and receptor expression in guinea pigs under different light sources (translated title)

Additional evidence from natural and artificial lighting. After 12 weeks, guinea pigs on standard feed had higher retinal retinoic acid under artificial light sources than under natural light. The investigators measured retinoic acid in retinal tissue by high-performance liquid chromatography (HPLC). This comparison supports a role for the lighting environment. The published abstract does not isolate illuminance from spectrum or other differences between light sources.

Selection for this edition: each list includes findings that support its heading. The same publication appears twice when separate experiments answer two different questions.

2 Retinoic acid can weaken the sclera or reduce production of its matrix

The mouse experiment directly measured stiffness. The primate and guinea pig studies identify changes in the extracellular matrix that helps the sclera maintain its structure.

May 2023 · Brown et al. · IOVS 64(5), 22

Exogenous All-Trans Retinoic Acid Induces Myopia and Alters Scleral Biomechanics in Mice

Mice given oral atRA developed a myopic shift. At matched levels of strain, their sclera was approximately 30% less stiff and 60% more permeable than control sclera. This is direct mechanical evidence of scleral weakening after atRA administration.

May 2006 · Troilo, Nickla, Mertz and Summers Rada · IOVS 47, 1768–1777

Change in the synthesis rates of ocular retinoic acid and scleral glycosaminoglycan during experimentally altered eye growth in marmosets

Adding RA to cultured marmoset sclera suppressed synthesis of glycosaminoglycans in a dose-dependent manner. These molecules are components of the scleral matrix. In the living animals, faster-growing eyes also showed higher ocular RA synthesis and lower scleral glycosaminoglycan synthesis.

Apr 2010 · C. Li et al. · Molecular Vision 16, 689–697

All-trans retinoic acid regulates the expression of the extracellular matrix protein fibulin-1 in the guinea pig sclera and human scleral fibroblasts

Guinea pigs given RA had longer eyes and weaker scleral staining for aggrecan, a matrix proteoglycan. Scleral fibulin-1 staining increased, providing additional evidence of matrix remodeling.

Dec 2024 · Zou et al. · Experimental Eye Research 249, 110155

Monochromatic light effects on refractive error, cone cell density and retinoic acid signaling in dorsal and ventral retina in guinea pigs

Under green light, guinea pigs had higher retinal RA signaling, less scleral collagen I and thinner sclera. Blue light produced the reciprocal pattern. This study links higher RA with reduced scleral collagen and thickness by association.

3 Blue light can increase retinal dopamine content or ocular markers of release

The studies identify where dopamine was measured. Vitreous DOPAC, a dopamine metabolite, provides an indirect measure of retinal release.

2021 · Tian et al. · IOVS 62(12), 20

The Role of Dopamine in Emmetropization Modulated by Wavelength and Temporal Frequency in Guinea Pigs

After four weeks of exposure, guinea pigs under 440 nm blue light had higher retinal tissue dopamine content than those under white light, pooling across temporal frequencies (P = 0.004). This finding specifically supports increased dopamine retained in retinal tissue.

Sep 2023 · Carpena-Torres et al. · Experimental Eye Research 234, 109604

Increased ocular dopamine levels in rabbits after blue light stimulation of the optic nerve head

Blue stimulation of the rabbit optic nerve head increased dopamine measured in the vitreous after one and ten minutes. Aqueous dopamine also increased after ten minutes. The investigators measured dopamine itself in both ocular fluids.

2018 · Wang, Schaeffel, Jiang and Feldkaemper · IOVS 59, 4413–4424

Effects of Light of Different Spectral Composition on Refractive Development and Retinal Dopamine in Chicks

After 30 minutes of 470 nm exposure, vitreous DOPAC was 1.70 ng/0.1 g in exposed chick eyes versus 1.31 in covered fellow eyes, approximately 30% higher. This metabolite response supports light-stimulated release of retinal dopamine.

Oct 2024 · Lu and Tong · BMC Ophthalmology 24, 475

Impact of red and blue monochromatic light on the visual system and dopamine pathways in juvenile zebrafish

In juvenile zebrafish, measured whole-eye dopamine increased with the intensity of 440 nm light. This provides additional evidence for an ocular dopamine response to short-wavelength light.

4 Increasing dopamine availability can transiently reduce retinal retinoic acid

One independent mouse study directly measured retinal atRA after administering the dopamine precursor L-DOPA.

Mar 2025 · Talwar et al. · IOVS 66(3), 37

Modulation of All-Trans Retinoic Acid by Light and Dopamine in the Murine Eye

Talwar and colleagues gave L-DOPA or saline to dark-adapted mice before exposure to 59 lux. Retinal atRA was 41.5% lower in the L-DOPA group at five minutes and 23.4% lower at fifteen minutes. By sixty minutes the groups were statistically comparable, establishing the time window of the effect.

Time in light	L-DOPA	Saline	Difference
5 min	23.64	40.40	41.5% lower
15 min	29.64	38.71	23.4% lower
60 min	35.85	40.23	10.9% lower*

Retinal atRA means in pmol/g. Percentage difference is calculated relative to saline. $P < 0.001$ at 5 minutes and $P < 0.05$ at 15 minutes. *At 60 minutes, $P = 0.230$.

July 2025 · Li Linfang et al. · Journal of Hainan Medical University 31(13), 961–969

Effects of the Rizhong dietary formula on eye development, retinal RA and DA levels, and receptor expression in guinea pigs under different light sources (translated title)

Independent evidence of an inverse association. The investigators assigned 64 guinea pigs to eight groups and measured both retinal dopamine and retinoic acid by HPLC at 12 weeks. Under the same light source, animals receiving the dietary formula had higher retinal dopamine and lower retinal retinoic acid than controls on standard feed. Because diet was the intervention, whether dopamine mediated the reduction remains open.

5 Dopamine receptor stimulation supports scleral oxygenation and thickness

These animal studies measured scleral or choroidal changes after dopamine-receptor stimulation. Reduced scleral hypoxia is the most direct evidence of a favorable scleral response.

Nov 2020 · X. Zhou et al. · IOVS 61(13), 25

Increased Choroidal Blood Perfusion Can Inhibit Form Deprivation Myopia in Guinea Pigs

In form-deprived guinea pigs, two weeks of apomorphine, a dopamine-receptor agonist, helped preserve choroidal blood perfusion and significantly reduced scleral hypoxia relative to vehicle ($P < 0.01$, Figure 3E–F). Tissue staining directly measured the scleral response.

Apr 2026 · Mathis et al. · Experimental Eye Research 265, 110904

Interactions of choroid and sclera in the myopia model of the chicken

In chicks, apomorphine increased choroidal thickness. Changes in choroidal thickness tracked with thickness changes in both the fibrous and cartilaginous scleral layers after dopamine-receptor manipulation. The measured endpoint was an acute structural response.

Nov 2010 · Nickla, Totonelly and Dhillon · Experimental Eye Research 91, 715–720

Dopaminergic agonists that result in ocular growth inhibition also elicit transient increases in choroidal thickness in chicks

In negative-lens-treated chicks, the dopamine-receptor agonists apomorphine and quinpirole inhibited excessive ocular elongation and produced transient choroidal thickening. The choroidal response supports a possible intermediate step between retinal signaling and changes in the sclera.