Nature Cell and Science 2025;3(2):77–78
https://doi.org/10.61474/ncs.2025.00020

Editorial

OPEN ACCESS

Is It Safe to Use Repeated Low-level Red Light Therapy in Children with Myopia?

Peng Zhou[1,2*]

[1]*Department of Ophthalmology, Parkway Gleneagles Medical and Surgical Center, Shanghai, China;* [2]*Department of Ophthalmology, Shenton Health Hong Qiao Medical Center, Shanghai, China*

[*]**Correspondence to:** Peng Zhou, Department of Ophthalmology, Parkway Gleneagles Medical and Surgical Center, 389 Nanjing Xi Rd, Shanghai 200032, China. ORCID: https://orcid.org/0000-0002-1744-5167. Tel: +86-21-63755588, Fax: +86-21-63755588, E-mail: drzhoupeng@gmail.com

Citation of this article: Zhou P. Is It Safe to Use Repeated Low-level Red Light Therapy in Children with Myopia? *Nat Cell Sci* 2025;3(2):77–78. doi: 10.61474/ncs.2025.00020.

Myopia is a major global public health concern, with China having one of the highest prevalence rates among children and adolescents.[1] Among various strategies to prevent myopia progression and slow its development, repeated low-level red light (RLRL) therapy has emerged as a popular yet controversial option. Unlike photobiomodulation, which utilizes low-energy light (including red and near-infrared light) to modulate cellular functions, RLRL therapy employs a specific wavelength of red light (typically 650 nm) to delay axial elongation and refractive error progression by enhancing cellular metabolism and energy supply. However, the rapid adoption of RLRL has raised challenges, including regulatory and safety concerns. Although some studies report its efficacy and safety over a 12-month period, the ophthalmology community remains divided on its long-term implications.

Out of paramount safety considerations, China's National Medical Products Administration implemented a significant regulatory upgrade in 2023 by reclassifying RLRL therapy devices as Class III medical devices—the highest risk category under China's medical device classification system—thereby imposing more stringent premarket approval requirements, including mandatory clinical evaluation, enhanced quality system regulations, and rigorous post-market surveillance to ensure comprehensive safety monitoring of these optical intervention devices used in pediatric myopia management.[2]

In April 2025, a research team reported a retrospective multicenter cohort study that analyzed 99 myopic children aged five to sixteen years,[3] comparing RLRL-treated subjects with controls. They found reduced foveal cone density in the RLRL group along with a higher incidence of abnormal retinal signals and drusen-like lesions. Notably, one case of RLRL-associated retinal changes showed improvement after treatment discontinuation. These findings suggest potential safety concerns regarding RLRL therapy for childhood myopia, highlighting the need for further investigation into its long-term safety and efficacy before widespread clinical application can be recommended.

However, in the same issue of the journal, an accompanying commentary pointed out several methodological limitations that significantly constrain the reliability of the study's conclusions.[4] First, the retrospective study design lacked randomization and, crucially, baseline adaptive optics scanning laser ophthalmoscopy (AOSLO) images prior to red light exposure, making it impossible to determine true changes in cone density following treatment. Second, the assessment of red light dosage and treatment adherence relied entirely on parental recall, introducing substantial potential for reporting bias. Moreover, the study failed to measure critical device parameters such as output power and spot size, further compromising the validity of the findings. From a statistical perspective, the analysis neither adequately accounted for the high interocular correlation between eyes nor clearly addressed whether multiple regions of interest within each imaged eye were properly considered in the statistical model. These substantial methodological shortcomings suggest the need for cautious interpretation of the reported results.

The reports have sparked intense debate in the ophthalmology community regarding the safety of RLRL treatment for childhood myopia. In June 2025, an article published in the *Chinese Journal of Experimental Ophthalmology* proposed a three-pronged approach to improve RLRL safety evaluation[5]: (1) research design — conducting multicenter prospective cohort studies with diverse populations varying in myopia severity, ethnicity, and age, while standardizing device parameters and real-time adherence monitoring through combined AOSLO, optical coherence tomography, and multifocal electroretinography to longitudinally track retinal structural and functional changes; (2) safety management — establishing a global registry platform mandating adverse event reporting by manufacturers and developing risk threshold models for dynamic safety monitoring; and (3) mechanism exploration — employing multi-omics technologies to elucidate red light's effects on cone cell metabolism, phototransduction pathways, and oxidative stress networks, while identifying early-warning biomarkers for potential damage.

This ongoing discussion emphasizes that therapeutic safety must remain the paramount consideration. Before any myopia control treatment is applied to children, comprehensive testing in animal models should be mandatory to prioritize safety evaluation and prevent potential long-term risks to the developing visual system, while simultaneously optimizing treatment protocols. Appropriate animal studies should first be conducted to assess the long-term safety and efficacy of RLRL treatment through analogous biological and physiological processes. This precaution is particularly cru-

Received: July 05, 2025 | **Revised:** July 22, 2025 | **Accepted:** July 24, 2025 | **Published online:** July 31, 2025

cial for complex conditions like myopia, which involve multiple facets of ocular development. The principle of "safety first" must guide all therapeutic innovations targeting pediatric populations, especially when intervening in the delicate process of eye growth during childhood. Rigorous preclinical evaluation should establish not only treatment efficacy but, more importantly, rule out any potential adverse effects on retinal structure and function before human clinical trials commence. Only through such meticulous safety validation can we ensure that the benefits of RLRL therapy truly outweigh its risks for young, developing eyes.

The crux of the current debate centers on the necessity for RLRL safety assessment to be established upon standardized, longitudinal, and multidimensional evidence-based medicine. We strongly advocate implementing multicenter prospective cohort studies incorporating diverse populations stratified by refractive error severity, ethnicity, and age demographics, utilizing standardized irradiation parameters with real-time compliance monitoring, while employing multimodal imaging including AOSLO, optical coherence tomography, and functional assessments (such as multifocal electroretinography) to longitudinally evaluate structural and functional retinal changes. The establishment of a global RLRL registry mandating adverse event reporting by manufacturers, coupled with the development of risk stratification models, would facilitate proactive safety surveillance. Concurrently, mechanistic investigations should employ multi-omics approaches to delineate the regulatory networks of red light irradiation on cone photoreceptor metabolism, phototransduction cascades, and oxidative stress pathways, with the objective of identifying sensitive biomarkers for early detection of potential phototoxicity. This comprehensive framework would provide the requisite scientific rigor for establishing evidence-based safety guidelines in pediatric myopia intervention.

In summary, the study employed a multicenter cohort design and AOSLO imaging technology to focus on RLRL therapy and demonstrate potential reductions in cone photoreceptor density and retinal abnormalities in myopic children following treatment.[3] This provides critical evidence for evaluating the safety profile of this intervention.[3] These findings underscore the imperative to refine methodological approaches by addressing current limitations through more rigorous clinical trials with extended follow-up periods, standardized protocols, and comprehensive outcome measures to definitively establish the long-term safety and efficacy of RLRL therapy, ultimately facilitating evidence-based decision-making for its application in childhood myopia control and offering stronger clinical support for pediatric myopia management strategies. Based on current evidence, we believe the long-term safety of RLRL in children has not been sufficiently established.

Acknowledgments

None.

Funding

None.

Conflict of interest

PZ has served as an Executive Associate Editor for *Nature Cell and Science* since January 2024. The author declares no other conflicts of interest.

Author contributions

PZ is the sole author of the manuscript. The author has approved the final version and publication of the manuscript.

References

[1] Wang DD, Zhou P. Myopia: Pathogenesis and Intervention. Nat Cell Sci 2025;3(1):62–76. doi:10.61474/ncs.2024.00049.
[2] Wang YX, Wang N, Wong TY. Red Light Therapy for Myopia-Current Regulatory Changes in China. JAMA Ophthalmol 2025;143(3):197–198. doi:10.1001/jamaophthalmol.2024.5977, PMID:39847347.
[3] Liao X, Yu J, Fan Y, Zhang Y, Li Y, Li X, *et al*. Cone Density Changes After Repeated Low-Level Red Light Treatment in Children With Myopia. JAMA Ophthalmol 2025;143(6):480–488. doi:10.1001/jamaophthalmol.2025.0835, PMID:40272813.
[4] Duncan JL. Repeated Low-Level Red Light-More Than Meets the Eye? JAMA Ophthalmol 2025;143(6):488–489. doi:10.1001/jamaophthalmol.2025.0957, PMID:40272790.
[5] Zhang H, He X, Jie Y, Wei R, He M. Does repeated low-level red light therapy affect cone density in the macula of myopic children? Chin J Exp Ophthalmol 2025;43(6):496–498. doi:10.3760/cma.j.cn115989-20250516-00159.