IMI – Digest 2025

Dr. Nina Tahhan
PhD, MPH, **GradCertOcTher, BOptom(hons)**

IMI Executive Director and Taskforce Chair

Introduction
The IMI provides biennial white papers to offer evidence-based consensus guidance that is both scientifically rigorous and clinically practical. The accompanying Digests offer targeted updates on topics from earlier white papers. The 2025 Digest[1] presents focused updates in six areas: definitions and classification of myopia, clinical management guidelines, risk factors, accommodation and binocular vision, experimental models, and onset and progression in young adults.

Two areas are covered in this section including *pre-myopia* and a new consensus *nomenclature for surgical retinal conditions*.
Pre-myopia: *Hyperopic reserve* has become a primary focus in pre-myopia research, with cycloplegic spherical equivalent error established as the single best predictor of myopia onset.[2-7] *Hyperopic reserve* refers to the age-appropriate level of hyperopia that offers a protective buffer against the development of myopia, with higher levels required at younger ages to reduce the risk. Evidence suggests that Asian children may require a greater hyperopic reserve than children of other populations to reduce their risk of developing myopia.[8 9]
Evidence supports preventative interventions in pre-myopic children. Outdoor time remains a strongest protective factor, while emerging data show potential benefits of low-dose atropine, repeated low-level red-light therapy, and novel spectacle designs for delaying onset.
Retinal nomenclature: An international expert panel has developed a new OCT-based classification system for Myopic Traction Maculopathy to standardize diagnosis, monitor disease progression, and guide management. This framework improves consistency in both clinical care and research reporting.

Clinical management guidelines
This section highlights four key areas:
Preventative management: Delaying onset is critical, with each year of delay comparable to 2–3 years of treatment with current modalities.[10] While prevention offers clear long-term benefits, clinicians must weigh potential treatment risks and costs against uncertain outcomes in pre-myopic children, taking into account individual risk profiles, motivation, lifestyle, and resources.
Proactive management: Stronger evidence and global consensus have established proactive myopia management as the standard of care to reduce long-term vision and quality-of-life risks. Long-term studies confirm safety and sustained efficacy of optical interventions (e.g., dual-focus contact lenses, and peripheral defocus/contrast reduction spectacle lenses), with no rebound. Treatment selection should be personalized, with optical interventions often considered first-line due to their dual role in vision correction and myopia control. Patient experience and adherence to treatment remain central to optimizing outcomes, underscoring the importance of shared, informed decision-making.
Understanding treatment efficacy: New approaches incorporate comparisons with emmetropic growth patterns to distinguish physiological from abnormal elongation. These provide useful clinical context, though randomized controlled trials (RCTs) remain the gold standard. Future studies are encouraged to use established myopia control comparators rather than single vision lenses in their control groups.
Long-term management: Success is defined by slowed progression, sustained safety, good vision, quality of life, and treatment acceptance. Monitoring with cycloplegic refraction and axial length (where available) is essential, alongside ocular health surveillance given the strong association between axial length and morbidity. Recent longitudinal studies from Asia highlight the early onset of retinal changes in high myopia and the role of tessellated

fundus as an early marker of myopic macular degeneration. Proactive retinal monitoring, even in younger patients, is therefore a core component of long-term care.

Risk factors for myopia

Beyond RCTs, newer analytic approaches have strengthened causal evidence linking environmental exposures with myopia development.

Education versus age: Studies from China show that school grade, rather than chronological age, correlates most strongly with refractive error,[11,12] reinforcing the environmental impact of educational exposure.

Time outdoors: Remains the most reliable protective factor supported by extensive observational evidence and RCTs.[13,14] In Taiwan, policies promoting outdoor activity during school hours have been associated with stabilization or reversal of prevalence trends, as shown in population-based surveys and school studies.[15-17] The COVID-19 lockdowns offered further evidence, with sharp increases in myopia among younger children when outdoor activity was curtailed,[18-26] except where structured outdoor exposure was preserved.[17,27]

Near work and screen use: Screen use from television to smartphones has been linked with myopia in some studies, but findings remain inconsistent[28,29] and it is unclear whether digital devices pose a greater risk than other forms of near work. Importantly, the rise in myopia in East Asia predated widespread device use,[30,31] suggesting that reducing screen time alone is unlikely to impact prevalence without increasing outdoor activity.

Sleep: studies to date have examined associations between myopia and short or insufficient sleep duration, late bedtimes, delayed wake times, and sleep disturbances. However, findings to date are inconsistent.[32-40]

Accommodation and binocular vision

Current evidence indicates that changes in accommodative and binocular function with myopia control interventions are minimal and not associated with progression. While short-term studies suggest optical treatments (e.g., multifocal contact lenses, orthokeratology) can alter accommodation or vergence, long-term trials in children show these effects stabilize and do not impair function. Atropine at low concentrations has negligible impact.

Experimental models of emmetropization and myopia

Recent animal studies have expanded understanding of emmetropization and myopia, with models ranging from mice to primates. Findings reinforce the importance of light characteristics, with spectral composition, flicker, and spatial frequency all influencing eye growth, though results vary by species. Novel opsins (OPN3, OPN4, OPN5) have been implicated in non-image-forming pathways, highlighting potential links between circadian regulation, dopamine, and refractive development. The choroid and sclera are increasingly recognized as key sites of signaling and remodeling, with inflammation and extracellular matrix changes identified as potential therapeutic targets. These insights provide biological plausibility for clinical observations and help direct future translational therapies.

Onset and progression of myopia in young adults

Longitudinal and clinic-based data confirm that while most adults myopia remains stable, a proportion of young adults continue to progress. Average progression rates are modest (≈ –0.05 to –0.25 D/year), but progression is more common in academic environments and in high myopes, with cumulative shifts of up to –1 D reported between ages 20 and 50. Risk factors include baseline myopia, female sex, lower sun exposure, greater screen time, and genetic susceptibility. Clinically, ongoing monitoring into early adulthood is warranted, especially for higher-risk patients.

CONCLUSION

The IMI 2025 Digest emphasizes earlier identification and prevention, particularly through assessing hyperopic reserve and promoting outdoor time. Evidence supports proactive, individualized myopia management with safe, effective optical interventions. Accommodative and binocular vision effects of myopia control are minimal. Experimental models highlight new light-mediated and molecular mechanisms, and data confirm that some young adults, especially high myopes, continue to progress. Together, these updates reinforce a proactive, lifelong approach to myopia care.

ACKNOWLEDGMENTS

This IMI White Paper was summarised by Dr Nina Tahhan. A full list of the IMI taskforce members and the complete IMI white papers can be found at myopiainstitute.org. The publication and dissemination costs of the International Myopia Institute reports were supported by donations from the Brien Holden Vision Institute, Carl Zeiss Vision, CooperVision, EssilorLuxottica, Hoya, Thea, Alcon, and Oculus.

CORRESPONDENCE

Brien Holden Vision Institute Ltd
Level 4, North Wing, Rupert Myers Building, Gate 14 Barker Street,
University of New South Wales, UNSW NSW 2052
imi@bhvi.org

REFERENCES

1. Tahhan N, Bullimore MA, He X, et al. IMI—2025 Digest. *Investigative Ophthalmology & Visual Science* 2025;66(12):27-27. doi: 10.1167/iovs.66.12.27
2. Chen Y, Tan C, Foo LL, et al. Development and Validation of a Model to Predict Who Will Develop Myopia in the Following Year as a Criterion to Define Premyopia. *Asia Pac J Ophthalmol (Phila)* 2023;12(1):38-43. doi: 10.1097/APO.0000000000000591 [published Online First: 20230111]
3. French AN, Morgan IG, Mitchell P, et al. Risk factors for incident myopia in Australian schoolchildren: the Sydney adolescent vascular and eye study. *Ophthalmology* 2013;120(10):2100-8. doi: 10.1016/j.ophtha.2013.02.035 [published Online First: 20130511]
4. Han X, Liu C, Chen Y, et al. Myopia prediction: a systematic review. *Eye (Lond)* 2022;36(5):921-29. doi: 10.1038/s41433-021-01805-6 [published Online First: 20211013]
5. Ma Y, Zou H, Lin S, et al. Cohort study with 4-year follow-up of myopia and refractive parameters in primary schoolchildren in Baoshan District, Shanghai. *Clin Exp Ophthalmol* 2018;46(8):861-72. doi: 10.1111/ceo.13195 [published Online First: 20180416]
6. Zadnik K, Sinnott LT, Cotter SA, et al. Prediction of Juvenile-Onset Myopia. *JAMA Ophthalmol* 2015;133(6):683-9. doi: 10.1001/jamaophthalmol.2015.0471
7. McCullough S, Adamson G, Breslin KM, et al. Axial growth and refractive change in white European children and young adults: predictive factors for myopia. *Scientific reports* 2020;10(1):15189.
8. Tahhan N, He X, Saunders K, et al. Factors predicting myopia incidence in China and Europe. *Ophthalmic and Physiological Optics* 2025 doi: https://doi.org/10.1111/opo.13563
9. Chen Z, Gu D, Wang B, et al. Significant myopic shift over time: Sixteen-year trends in overall refraction and age of myopia onset among Chinese children, with a focus on ages 4-6 years. *J Glob Health* 2023;13:04144. doi: 10.7189/jogh.13.04144 [published Online First: 20231109]
10. Bullimore MA, Brennan NA. Myopia: An ounce of prevention is worth a pound of cure. *Ophthalmic Physiol Opt* 2023;43(1):116-21. doi: 10.1111/opo.13058 [published Online First: 20221005]
11. Ding X, Morgan IG, Hu Y, et al. The Causal Effect of Education on Myopia: Evidence That More Exposure to Schooling, Rather Than Increased Age, Causes the Onset of Myopia. *Invest Ophthalmol Vis Sci* 2023;64(4):25. doi: 10.1167/iovs.64.4.25
12. Ding X, Morgan IG, Hu Y, et al. Exposure to the Life of a School Child Rather Than Age Determines Myopic Shifts in Refraction in School Children. *Invest Ophthalmol Vis Sci* 2022;63(3):15. doi: 10.1167/iovs.63.3.15
13. He M, Xiang F, Zeng Y, et al. Effect of Time Spent Outdoors at School on the Development of Myopia Among Children in China: A Randomized Clinical Trial. *JAMA* 2015;314(11):1142-8. doi: 10.1001/jama.2015.10803
14. Wu PC, Tsai CL, Wu HL, et al. Outdoor activity during class recess reduces myopia onset and progression in school children. *Ophthalmology* 2013;120(5):1080-5. doi: 10.1016/j.ophtha.2012.11.009 [published Online First: 20130222]
15. Wang CY, Hsu NW, Yang YC, et al. Premyopia at Preschool Age: Population-based Evidence of Prevalence and Risk Factors from a Serial Survey in Taiwan. *Ophthalmology* 2022;129(8):880-89. doi: 10.1016/j.ophtha.2022.03.017 [published Online First: 20220322]

16. Wu PC, Chen CT, Chang LC, et al. Increased Time Outdoors Is Followed by Reversal of the Long-Term Trend to Reduced Visual Acuity in Taiwan Primary School Students. *Ophthalmology* 2020;127(11):1462-69. doi: 10.1016/j.ophtha.2020.01.054 [published Online First: 20200208]
17. Yang YC, Hsu NW, Wang CY, et al. Prevalence Trend of Myopia after Promoting Eye Care in Preschoolers: A Serial Survey in Taiwan before and during the Coronavirus Disease 2019 Pandemic. *Ophthalmology* 2022;129(2):181-90. doi: 10.1016/j.ophtha.2021.08.013 [published Online First: 20210821]
18. Alvarez-Peregrina C, Martinez-Perez C, Villa-Collar C, et al. Impact of COVID-19 Home Confinement in Children's Refractive Errors. *Int J Environ Res Public Health* 2021;18(10) doi: 10.3390/ijerph18105347 [published Online First: 20210517]
19. Evans BJW, Pentland L, Evans BEW, et al. Increasing myopia in Scotland at age of 3.5-5.5 years: A retrospective epidemiological study. *Ophthalmic Physiol Opt* 2025 doi: 10.1111/opo.13461 [published Online First: 20250227]
20. Hu Y, Zhao F, Ding X, et al. Rates of Myopia Development in Young Chinese Schoolchildren During the Outbreak of COVID-19. *JAMA Ophthalmol* 2021;139(10):1115-21. doi: 10.1001/jamaophthalmol.2021.3563
21. Ma D, Wei S, Li SM, et al. Progression of myopia in a natural cohort of Chinese children during COVID-19 pandemic. *Graefes Arch Clin Exp Ophthalmol* 2021;259(9):2813-20. doi: 10.1007/s00417-021-05305-x [published Online First: 20210721]
22. Ma M, Xiong S, Zhao S, et al. COVID-19 Home Quarantine Accelerated the Progression of Myopia in Children Aged 7 to 12 Years in China. *Invest Ophthalmol Vis Sci* 2021;62(10):37. doi: 10.1167/iovs.62.10.37
23. Wang J, Li Y, Musch DC, et al. Progression of Myopia in School-Aged Children After COVID-19 Home Confinement. *JAMA Ophthalmol* 2021;139(3):293-300. doi: 10.1001/jamaophthalmol.2020.6239
24. Wang W, Zhu L, Zheng S, et al. Survey on the Progression of Myopia in Children and Adolescents in Chongqing During COVID-19 Pandemic. *Front Public Health* 2021;9:646770. doi: 10.3389/fpubh.2021.646770 [published Online First: 20210428]
25. Xu L, Ma Y, Yuan J, et al. COVID-19 Quarantine Reveals That Behavioral Changes Have an Effect on Myopia Progression. *Ophthalmology* 2021;128(11):1652-54. doi: 10.1016/j.ophtha.2021.04.001 [published Online First: 20210414]
26. Zhang X, Cheung SSL, Chan HN, et al. Myopia incidence and lifestyle changes among school children during the COVID-19 pandemic: a population-based prospective study. *Br J Ophthalmol* 2022;106(12):1772-78. doi: 10.1136/bjophthalmol-2021-319307 [published Online First: 20210802]
27. Yang YC, Tsai DC, Wang CY, et al. The prevalence of myopia remains stable under tighter COVID-19 social restriction in preschoolers receiving a school-based eyecare program. *Acta Ophthalmol* 2024;102(1):e78-e85. doi: 10.1111/aos.15680 [published Online First: 20230505]
28. Foreman J, Salim AT, Praveen A, et al. Association between digital smart device use and myopia: a systematic review and meta-analysis. *Lancet Digit Health* 2021;3(12):e806-e18. doi: 10.1016/S2589-7500(21)00135-7 [published Online First: 20211005]
29. Lanca C, Yam JC, Jiang WJ, et al. Near work, screen time, outdoor time and myopia in schoolchildren in the Sunflower Myopia AEEC Consortium. *Acta Ophthalmol* 2022;100(3):302-11. doi: 10.1111/aos.14942 [published Online First: 20210617]
30. Morgan IG, French AN, Ashby RS, et al. The epidemics of myopia: Aetiology and prevention. *Prog Retin Eye Res* 2018;62:134-49. doi: 10.1016/j.preteyeres.2017.09.004 [published Online First: 20170923]
31. Morgan IG, Wu PC, Ostrin LA, et al. IMI Risk Factors for Myopia. *Invest Ophthalmol Vis Sci* 2021;62(5):3. doi: 10.1167/iovs.62.5.3
32. Chawla O, Singh A, Kumawat D, et al. Systematic Review of Sleep Duration and Development of Myopia. *Cureus* 2024;16(3):e56216. doi: 10.7759/cureus.56216 [published Online First: 20240315]
33. Hussain A, Gopalakrishnan A, Scott H, et al. Associations between systemic melatonin and human myopia: A systematic review. *Ophthalmic Physiol Opt* 2023;43(6):1478-90. doi: 10.1111/opo.13214 [published Online First: 20230811]
34. Jin E, Lee CE, Li H, et al. Association between sleep and myopia in children and adolescents: a systematic review and meta-analysis. *Graefes Arch Clin Exp Ophthalmol* 2024;262(7):2027-38. doi: 10.1007/s00417-023-06338-0 [published Online First: 20231213]
35. Liu XN, Naduvilath TJ, Sankaridurg PR. Myopia and sleep in children-a systematic review. *Sleep* 2023;46(11) doi: 10.1093/sleep/zsad162
36. Wang XX, Liu X, Lin Q, et al. Association between sleep duration, sleep quality, bedtime and myopia: A systematic review and meta-analysis. *Clin Exp Ophthalmol* 2023;51(7):673-84. doi: 10.1111/ceo.14277 [published Online First: 20230719]
37. Zhang Y, Tian S, Zou D, et al. Screen time and health issues in Chinese school-aged children and adolescents: a systematic review and meta-analysis. *BMC Public Health* 2022;22(1):810. doi: 10.1186/s12889-022-13155-3 [published Online First: 20220422]

38. Zhao H, Wu N, Haapala EA, et al. Association between meeting 24-h movement guidelines and health in children and adolescents aged 5-17 years: a systematic review and meta-analysis. *Front Public Health* 2024;12:1351972. doi: 10.3389/fpubh.2024.1351972 [published Online First: 20240507]
39. Zhao X, He Y, Zhang J, et al. Effects of Insufficient Sleep on Myopia in Children: A Systematic Review and Meta-Analysis. *Nat Sci Sleep* 2024;16:1387-406. doi: 10.2147/NSS.S472748 [published Online First: 20240918]
40. Zhou M, Li DL, Kai JY, et al. Sleep duration and the risk of major eye disorders: a systematic review and meta-analysis. *Eye (Lond)* 2023;37(13):2707-15. doi: 10.1038/s41433-023-02403-4 [published Online First: 20230123]