Contact Lens Update
CLINICAL INSIGHTS BASED IN CURRENT RESEARCH

Article Review: Ocular biometrics and uncorrected visual acuity for detecting myopia in Chinese school students

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Zhao, Ethan, et al. "Ocular biometrics and uncorrected visual acuity for detecting myopia in Chinese school students." Scientific Reports 12.1 (2022): 18644.

It is no secret to eye care professionals that myopia prevalence is on the rise and that the associated comorbidities can lead to permanent visual impairment. Investigating myopia further, tracking myopic prevalence, and providing myopia control interventions are only possible if the correct patients are identified. Large-scale myopia studies, vision screening environments, and patients or parents hesitant about eye drops can all create scenarios where cycloplegic refraction, the gold standard for myopia detection, is not possible. In this study, investigators sought to determine the ability of biometric markers and uncorrected visual acuity to detect myopia without the use of cycloplegia.

The Study

Zhao and colleagues undertook this challenge through recruitment of randomly selected students, from randomly selected schools in two Chinese cities. The study included a large number of participants (n = 3436) with a good distribution among the entire age range, 5-18 years, as well as a nearly equal number of male and female participants, making the results generalizable to a wide range of ages. However, since it only took place in China, we should exercise caution to generalize the results to other parts of the world.

All students underwent comprehensive visual evaluation by trained eye care professionals, with testing including: uncorrected distance visual acuity (UCVA), axial length (AL), corneal curvature radius (CR), anterior chamber depth (ACD), and spherical equivalent cycloplegic refractive error (SER).

To determine whether any of the measures could reliably detect myopia (defined as SER -0.5 D or worse in either eye), the authors first categorized the students from one of the cities, Jinyun, (n = 1938) into three groups by age: < 10 years, 10-14 years, or ≥ 15 years. They then calculated the sensitivity and specificity for each potential cutoff point for AL, AL/CR ratio, and UCVA, to determine the best age-specific cutoff for each. The authors then applied these determined "myopia positive" cutoffs to the students from the second city, Hangzhou (n = 1498) to validate their myopia-detecting ability. They also calculated the sensitivity and specificity for the determined cutoff points for the combination of AL/CR ratio and UCVA.

The Results

Cycloplegic refractive error was significantly correlated with axial length, anterior chamber depth, uncorrected visual acuity, and AL/CR ratio. It was not correlated with corneal radius. The correlation between SER and AL, as well as between SER and AL/CR ratio increased with age, which could mean that these screening measures, if found to be effective at detecting myopia, may be more effective for older ages compared to younger.

At all ages, the AL/CR ratio was significantly different between myopic and non-myopic students (overall means: 3.17 vs. 2.93), though the AL/CR ratio increased for both groups with increasing age. For example, the average AL/CR ratio for 5-6-year-olds was 2.88 for the non-myopes and 2.98 for the myopes, while the same metric was 2.99 for 18-year-old non-myopes and 3.24 for 18-year-old myopes. The increase in AL/CR ratio with age provides support for the authors' choice to determine age-specific cutoffs for the potential screening markers.

Determination of sensitivity and specificity for varying possible cutoffs for AL and AL/CR led to the following cutoff points:

	Axial Length (AL)	Axial Length / Corneal Radius (AL/CR)
< 10 years	>23.5mm	>3.00
10 – 14 years	>24.0mm	>3.06
≥ 15 years	>24.2mm	>3.08

Consistent with the increasing correlation between these metrics and SER with age, the sensitivity and specificity of these metrics were greatest for the oldest age group and lowest for the youngest age group. Sensitivity ranged from approximately 73% (AL in < 10-year-olds) to 90% (AL/CR ratio in ≥ 15-year-olds) and specificity from approximately 74% (AL in 10–14-year-olds) to 91% (AL/CR ratio in ≥ 15-year-olds). For all age groups, the AL/CR ratio had a higher sensitivity and specificity than did AL, indicating it is likely the better metric for detecting myopia.

Remember that sensitivity refers to a screening tool's ability to detect a disorder. Based on the data provided in this paper, of 100 myopic kids between ages 5 and less than 10 years, using an axial length greater than 23.5mm as the myopia positive indicator will detect 73 of them, but not the remaining 27. Conversely, the specificity of a screening tool refers to its ability to screen out those without the condition. Of 100 non-myopic kids aged 10-14 years, an axial length cutoff of greater than 24mm will correctly screen out 74 of them, while incorrectly identifying 26 of them as myopic.

The AL/CR ratio being a better screener than AL was confirmed by area under the curve (AUC) metrics, however, the difference is marginal. While both AL and AL/CR had AUCs greater than 0.90 (considered to be an outstanding AUC for screening tools), the AL/CR ratio had higher AUCs for the data set from Jinyun (0.97 vs 0.93 for AL), the data set from Hangzhou (0.956 vs. 0.911), and both data sets combined (0.963 vs. 0.922). The AUC data suggests that age-specific cutoffs for either AL or AL/CR ratio are good screening tools for detecting myopia.

The authors also investigated whether combining UCVA with the AL/CR ratio would improve the ability to detect myopic SER. They determined optimal age-specific cutoffs for UCVA to combine with the AL/CR ratio. For those under 10 years, they used UCVA worse than 20/32. For both of the older age groups, they used worse than 20/25. For all age groups, this increased the sensitivity, but slightly decreased the specificity, meaning that more kids with myopia were correctly identified, however, slightly more non-myopic kids were incorrectly identified as being myopic.

Takeaways

The major takeaway from this large-scale, cross-sectional myopia study is that some biometric measures taken under noncycloplegic conditions can serve as useful screening tools for myopia detection, when cycloplegic refractive assessment is not possible. Axial length, the AL/CR ratio, or the AL/CR ratio in combination with UCVA can all detect myopia with good success. For all these screening metrics, the older a child is, the more accurate it will be as a screening tool.

These noncycloplegic metrics are going to be very useful in large-scale myopia studies and prevalence estimation, which will be critical as researchers continue to investigate the condition. For the clinician, these metrics can be useful in vision screening situations where a cycloplegic evaluation is not possible. They could also be useful in confirmation of myopia in a patient resistant to dilation in the clinical setting. Axial length alone, at the provided age-specific cutoffs, has a sensitivity of approximately 81% and specificity of approximately 83%. The AL/CR ratio, at the provided age-specific cutoffs, has a sensitivity of approximately 87% and specificity of approximately 89%. It is important to remember, however, that these cutoffs were determined in a cohort of Chinese schoolchildren, and therefore the optimal cutoffs may differ in children from other parts of the world.

Clinicians ought to be on the lookout for literature that provides screening tools for myopia within their own patient demographic. Additionally, as myopia control treatments become increasingly sought after and prescribed, access to measurement of axial length is increasingly relevant. The findings from this well-done study by Zhao and colleagues provide additional evidence that eye care providers treating children should consider the measurement of more than just refractive error; biometric measures are also important.