Predicting Myopia Onset and progression (PreMO): an evidence-based risk indicator for eye care practitioners.

Stratification of a child's risk for developing myopia can be undertaken using the PreMO risk indicator. The risk indicator provides advice and guidance for children and their parents on the likelihood of future myopia and provides a structure with which to discuss strategies to delay onset (Part 1). For myopic children, the indicator can be used in combination with professional judgement to select evidence-based management options (Part 2). Because the PreMO is derived primarily from NICER Study outcomes, it is best suited for use with primary school children of white ethnicity living in the UK.

Part 1: Risk Indicator- stratifying risk of future myopia

To determine child's risk of myopia you will need the following information:

1.) Age of the child (years) 2.) Parental history of myopia 3.) Cycloplegic refractive error (using spherical equivalent refraction [SER]) * 4.) Axial Length **

Use either Table 1a for children 6-8 years OR Table 1b for children 9-10 years to calculate your patient's 'Risk Score'. The colour coding used in the tables relates to the evidence-derived risk of remaining emmetropic (green), or becoming myopic by approximately 10 (red), 13 (orange), or 16 (yellow) years of age and corresponds to the management in Table 1c.

6-8-Year-Old Children

Table 1a: Assessing risk of myopia development			
Risk factor for myopia development			Score assigned
Genetic	1. Parental myopia	Neither parent myopic	0
		One parent myopic	2
		Two parents myopic	3
Refractive	2. Cycloplegic SER *	Greater than +1.00D	0
		+0.75D to +1.00D	2
		Less than +0.75D	3
	3. Axial Length **	Less than 22.93mm	0
		22.94mm to 23.11mm	1
		23.12mm to 23.18mm	2
		23.19 mm or greater	3
		Risk Score (0-9)	

*If cycloplegic SER is not available use these non-cycloplegic estimations for risk scores[2]	
Non cycloplegic SER (D)	
Greater than +0.75	0
+0.325 to +0.75	2
Less than +0.325	3

**If axial length is unavailable, use these estimations for risk score from average K (mm) & SER (D)

	Cycloplegic SER (D)				
	-0.25	0.00 or +0.25	+0.50 or +0.75	+1.00 or +1.25	+1.50 or +1.75
K(mm)					
7.4 or less	0	0	0	0	0
7.5	1	0	0	0	0
7.6	3	2	1	0	0
7.7	3	3	2	1	0
7.8	3	3	3	2	1
7.9	3	3	3	3	2
8.0 or greater	3	3	3	3	3

9-10-Year-Old Children

Table 1b: Assessing risk of myopia development			
Risk factor for myopia development			Score assigned
Genetic	1. Parental myopia	Neither parent myopic	0
		One parent myopic	1
		Two parents myopic	2
Refractive	2. Cycloplegic SER *	Greater than +0.875D	0
		+0.375D to +0.875D	1
		Less than +0.375D	2
	3. Axial Length **	Less than 23.33mm	0
		23.33mm to 23.61mm	1
		23.62 mm or greater	2
		Risk Score (0-6)	

* If cycloplegic SER is not available use these non-cycloplegic estimations for risk scores[2]	
Non cycloplegic SER (D)	
Greater than +0.625	0
+0.125 to +0.625	1
Less than +0.125	2

** If axial length is unavailable, use these estimations for risk score from average K (mm) & SER (D)

	Cycloplegic SER (D)				
	-0.25	0.00 or +0.25	+0.50 or +0.75	+1.00 or +1.25	+1.50 or +1.75
K(mm)					
7.6 or less	0	0	0	0	0
7.7	1	1	0	0	0
7.8	2	1	1	0	0
7.9	2	2	1	1	0
8.0	2	2	2	1	1
8.1	2	2	2	2	1
8.2 or greater	2	2	2	2	2

* Result of autorefraction (or retinoscopy) >20 minutes after instillation of 1% Cyclopentolate HCl. Use the result from the least hyperopic eye/most emmetropic eye.

Use the conversion table for non-cycloplegic subjective refraction results if cycloplegic refraction values are not available. Cycloplegic refraction is encouraged to determine the risk score more accurately.

** If you do not have access to axial length measures use the conversion table to estimate the axial length risk score based on SER (D) and mean anterior corneal radius of curvature (K, mm).

Interpreting the Risk Score

Evidence-Informed Management

Use the 'Risk Score' calculated in Table 1a or 1b to indicate the child's risk of becoming myopic, the age at which myopia is likely to develop and the suggested recall schedule and management advice from Table 1c.

RE-TEST INTERVAL: The suggested recall for patients at moderate to high risk of developing myopia by 10 or 13 years of age is one year until at least 13 years of age[1,4] in the absence of emergent signs/symptoms, significant existing astigmatism and/or anisometropia or a pre-existing binocular vision anomaly.

ADVICE: All patients who are 'at risk' of myopia development (Risk Score ≥1) should receive evidence-informed environmental and lifestyle advice including promoting spending increased time outdoors (>40 mins per day) and decreasing time spent on near activities e.g. smart phones and computers.

The higher the score, the higher the risk of future myopia and of myopia occurring at an earlier age. Earlier onset is likely to result in higher magnitudes of myopia long-term.[1] This information can be relayed to parents to highlight their child's relative risk and stress the importance of regular eye examinations and adherence to environmental and lifestyle advice.

Table 1c: Predicted risk of myopia development and suggested management and advice

Score	Risk of myopia development	Predicted refractive outcome	Management	
			Suggested recall †	Advice
0	LITTLE/NO RISK	Likely to remain emmetropic	2 years	Little/No risk of myopia development
1-3	LOW RISK	Likely to be myopic by 16 years		Environment & lifestyle modifications‡
4-6	MODERATE RISK	Likely to be myopic by 13 years	1 year	
7-9	HIGH RISK	Likely to be myopic by 10 years		

† In the absence of emergent signs or symptoms during recall period or presence of significant refractive error (hyperopia, anisometropia or astigmatism) or binocular vision anomaly
‡ With advice on implementation of environmental modifications and lifestyle advice (e.g. increasing time spent outdoors >40 mins per day, decreasing time spent on near activities e.g. smart phones and computers)[5]

Part 2: Management of myopia progression if child becomes myopic >6 years of age.

Use Tables 2a and 2b below in conjunction with your clinical judgment to determine the most appropriate recall interval and patient advice dependent on refractive status, age and rate of progression of cycloplegic refractive error (using SER).

To determine an evidence-based management and recall schedule for myopic children you will need:

1.) Cycloplegic SER result from two or more successive eye examinations 2.) An estimate of annual progression in SER

Annual progression of SER can be calculated using the following formula: Annual Progression (D) = SER2-SER1/Years between tests

Table 2a: Myopia management and suggested recall schedule

Risk of myopic progression			Score assigned
Demographic	1. Age of child	13 years old or more	0
		Less than 13 years old	1
Refractive	2. Annual progression in SER (D)	Less than 0.50D	0
		0.50D or more	1
		Risk Score (0-2)	

Evidence-Informed Management

Use the 'Risk Score' calculated in Table 2a to indicate the child's risk of myopic progression and the suggested recall schedule and management advice from Table 2b.

RE-TEST INTERVAL: The suggested recall for patients at risk of myopic progression is one year until at least 13 years of age in the absence of emergent signs/symptoms, significant existing astigmatism and/or anisometropia or a pre-existing binocular vision anomaly. If the child is less than 13 years of age and has shown an annual myopic progression of >0.50D, they are at risk of fast myopic progression and should be reviewed in six months. Table 2a can be used at subsequent review to re-evaluate the future risk of progression.

ADVICE: The optometrist should discuss myopia control strategies with patients who are at moderate to high risk of myopia progression (score 1 or 2).**

Where the risk of myopia progression is identified as 'Little/No Risk', this should be considered in the context of the child's current environment/lifestyle. Risk of progression should be re-evaluated at subsequent review.

Table 2b: Predicted risk of myopia progression and suggested management and advice

Score	Risk of myopia progression & predicted refractive outcome		Management	
			Suggested recall *	Advice
0	LITTLE/NO RISK	Stable/Slow progression of myopia Low magnitude of myopia long-term	2 years	Low risk of myopic progression
1	MODERATE RISK	Moderate progression of myopia Moderate magnitude of myopia long-term	1 year	Discuss myopia control strategies **
2	HIGH RISK	Fast progression of myopia High magnitude of myopia long-term	6 months	

* in the absence of symptoms, significant refractive error (hyperopia, anisometropia or astigmatism) or BV anomaly
** if within practitioners' level of clinical competency and in line with the College of Optometrists 'Myopia Management Guidance for Optometrists'

REFERENCES

The PreMO Risk Indicator has been developed primarily from the NICER Study research. Supporting references are included below:

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