Seasonal Progression of Myopia: A Review of the Literature

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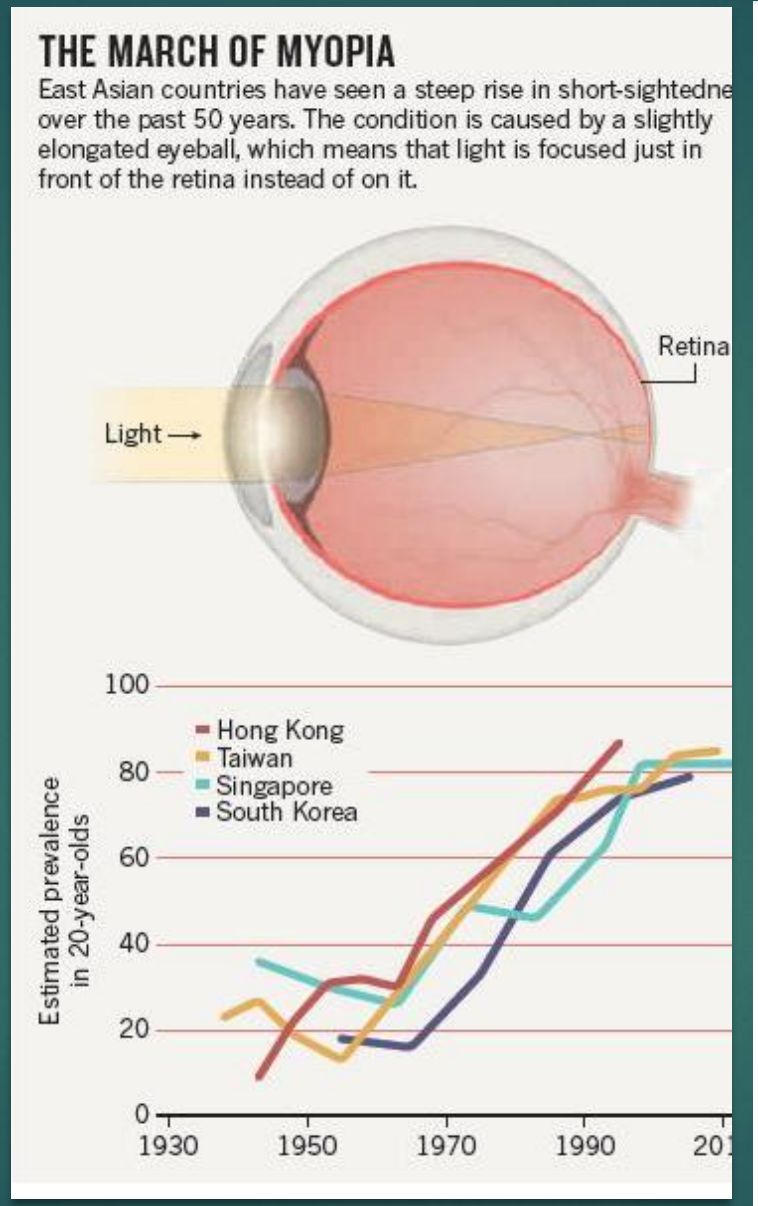
So why is Myopia so Important?

Increasing Myopia will increase blindness from

- Glaucoma
- Retinal Detachment
- Cataract
- Myopic maculopathy



From: The Economist, 2022

THE MYOPIA BOOM

SHORT-SIGHTEDNESS IS REACHING EPIDEMIC PROPORTIONS. SOME SCIENTISTS THINK THEY HAVE FOUND A REASON WHY.

BY ELIE DOLGIN

The southern city of Guangzhou has long held the largest eye hospital in China. But about five years ago, it became clear that the Zhongshan Ophthalmic Center needed to expand.

More and more children were arriving with the blurry distance vision caused by myopia, and with so many needing eye tests and glasses, the hospital was bursting at the seams. So the centre began adding new testing rooms — and to make space, it relocated some of its doctors and researchers to a local shopping mall. Now during the summer and winter school holidays, when most diagnoses are made, "thousands and thousands of children" pour in every day, says ophthalmologist Nathan Congdon, who was one of those uprooted. "You literally can't walk through the halls because of all the children."

East Asia has been gripped by an unprecedented rise in myopia, also known as short-sightedness. Sixty years ago, 10–20% of the Chinese population was short-sighted. Today, up to 90% of teenagers and young adults are. In Seoul, a whopping 96.5% of 19-year-old men are short-sighted.

Glasses have become the rule, not the exception, in Chinese universities.

Other parts of the world have also seen a dramatic increase in the condition, which now affects around half of young adults in the United States and Europe — double the prevalence of half a century ago. By some estimates, one-third of the world's population — 2.5 billion people — could be affected by short-sightedness by the end of this decade. "We are going down the path of having a myopia epidemic," says

From: Dolgin, 2015

Background and Purpose

- The change in rate of myopia progression between summer and winter is a phenomenon which has been reported multiple times by different studies.
- The purpose of this study is to consolidate the current literature available on the topic.
- The effects of the latitude and school calendar differences were also examined.

Methodology

- A broad search of Medline via OvidSP was undertaken to identify as many studies as possible.
- Search terms: myopia, seasons, seasonal progression, winter, summer, refractive error, axial, elongation, ocular, lengthening.

Inclusion criteria:

- **Measured axial length or refractive error at 3- or 6-month intervals**
- Tracked and reported the longitudinal change in these parameters by seasons.
- Studies with interventions such as orthokeratology

Exclusion criteria:

- Studies published prior to 2000.

Results

12 Studies met the inclusion criteria

Myopic Participants without intervention: *Fulk et al. 2002[12], Fujiwara et al. 2012[14], Donovan et al. 2013[15], Cui et al. 2013[16] , Gwiazda et al. 2014[15]*

Myopic Participants undergoing Orthokeratology: *Ding et al. 2025[18], Tang et al. 2025[19]*

General Population Sample: *Rusnak et al. 2018[20], Hecova et al. 2023[21], Tsai et al. 2019[22], Ulaganathan et al. 2019[23], Nilsen et al. 2023[24]*

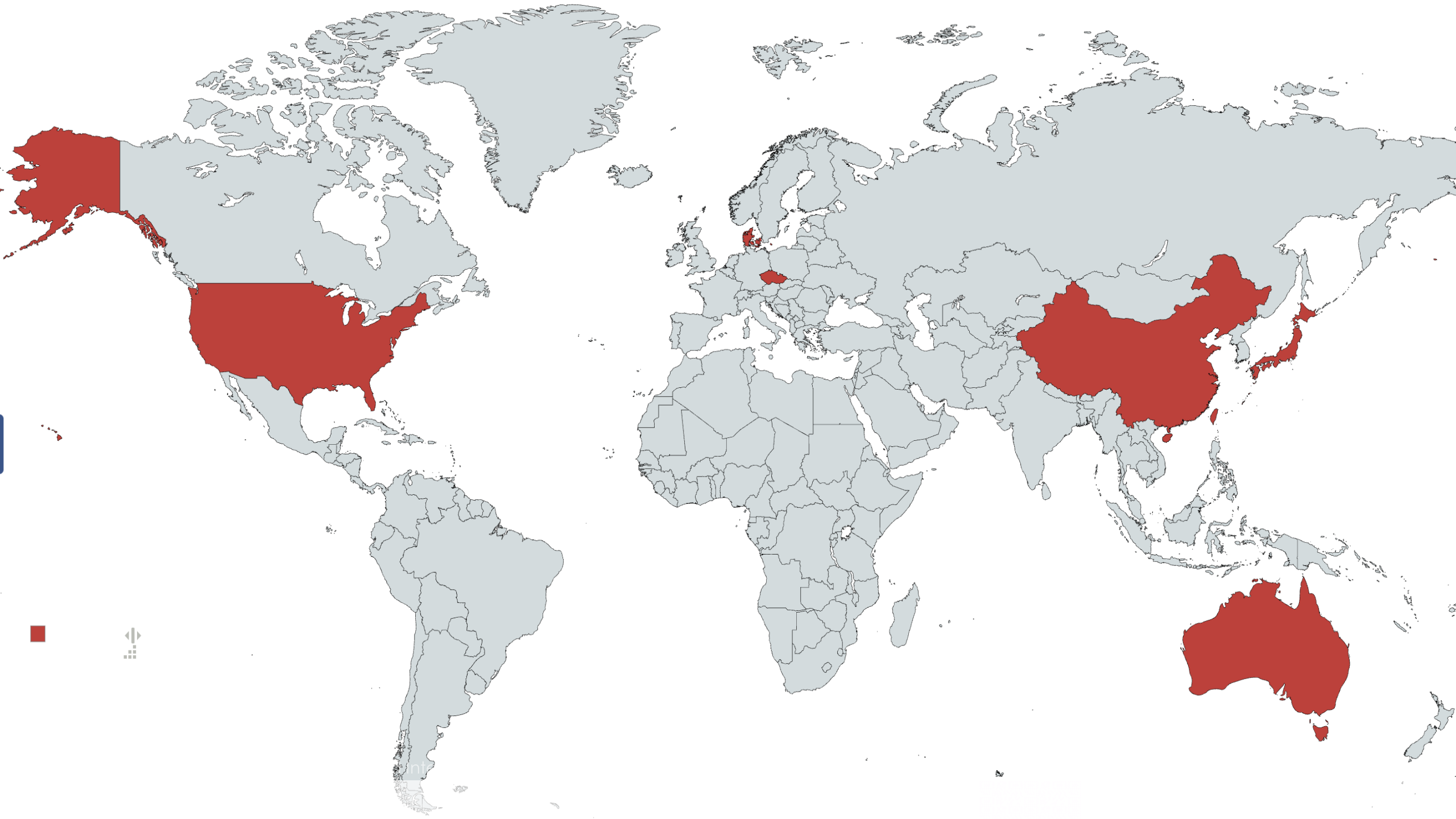


Table 1: Studies on myopic (RE >-2.5D) participants without intervention:

Mean progression	Fulk et al, 2002 USA		Fujiwara et al, 2012 Japan		Donovan et al, 2013 China		Cui et al, 2013 Denmark		Gwiazda et al, 2014 USA		Ulaganathan et al. 2019 Australia	
	RE	AL	RE	AL	RE	AL	RE	AL	RE	AL	RE	AL
Winter	-0.31D	0.12mm	-0.28 D	0.17 mm	-0.35 D	0.24mm	-0.32 D	0.19mm	-0.35 D	n/a	n/a	0.03mm
Summer	-0.11D	0.05mm	-0.35 D	0.14 mm	-0.14 D	0.17mm	-0.26 D	0.12mm	-0.14 D	n/a	n/a	0.04mm
Winter as % Summer	282%	240%	80%	121%	250%	141%	123%	158%	250%	n/a	n/a	75%
Sample size	37		92		85		235		358		22	
Sample age range	6.8-12.9 yrs		11.4±1.7 yrs		6-12 yrs		8-14 yrs		6-12 yrs		18-30 yrs	
Cycloplegia	yes		no		yes		yes		no		n/a	
Statistically Significance	p<0.03	p<0.01	P>0.05	p=0.04	P<0.00	P<0.00	P=0.00	P=0.00	p=0.00	n/a	n/a	p=0.66

Table 2: Studies on myopic participants undergoing orthokeratology

Mean progression	Ding et al. 2025 China	Tang et al. 2025 China
	AL	AL
Winter	0.12mm	0.09mm
Summer	0.07mm	0.05mm
winter as % summer	167%	180%
Sample size	600	116
Sample age range	7-13 yrs	7-12 yrs
Statistically Significant	$p<0.01$	$p<0.01$

Table 3: Studies on a general population sample

Mean progression	Rusnak et al. 2018 Czechia		Hecova et al. 2023 Czechia		Tsai et al. 2019 Taiwan		Ulaganathan et al, 2019 QLD, Australia	
	RE	AL	RE	AL	RE	AL	RE	AL
Winter	n/a	0.06mm	n/a	0.072mm	-0.25 D	n/a	n/a	0.021mm
Summer	n/a	0.03mm	n/a	-0.005 mm	-0.17 D	n/a	n/a	0.017mm
Winter as % Summer	n/a	200%	n/a	-1440%	147%	n/a	n/a	124%
Sample size	198		264		6790		43	
Sample age range	12 yrs		10.9-13.6 yrs		7-8 yrs		18-30	
Cycloplegia					yes		yes	
Statistically Significant	n/a	p=0.00	n/a	p=0.00	n/a	p=0.00	n/a	p=0.21

What does our Australian data say?

Data from control arm of WA ATOM study

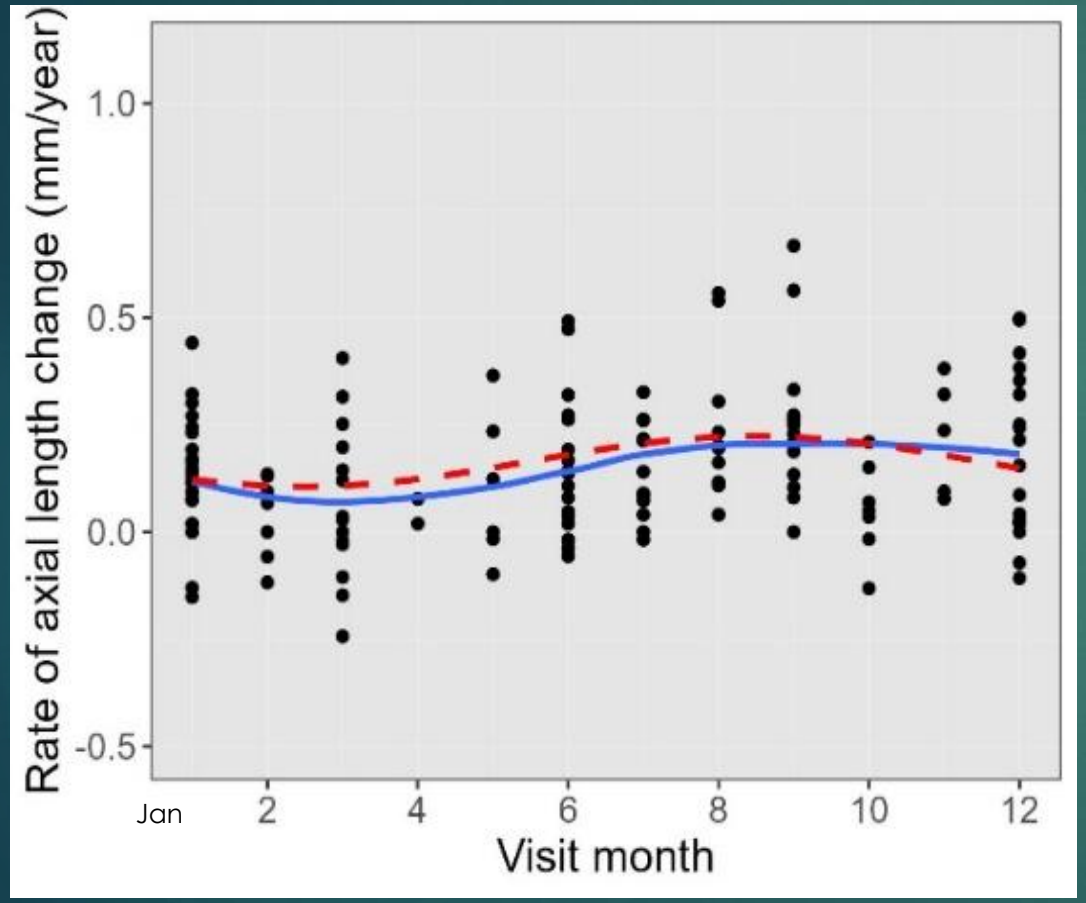


Figure 1: Rates of axial eye growth of WA-ATOM participants over 2 years showing myopic eye growth is fastest in winter. Blue line: Lowess-smoothed mean, red line: cosine fit (Lee et al, 2022)

Raine Gen-3 AL Measurement

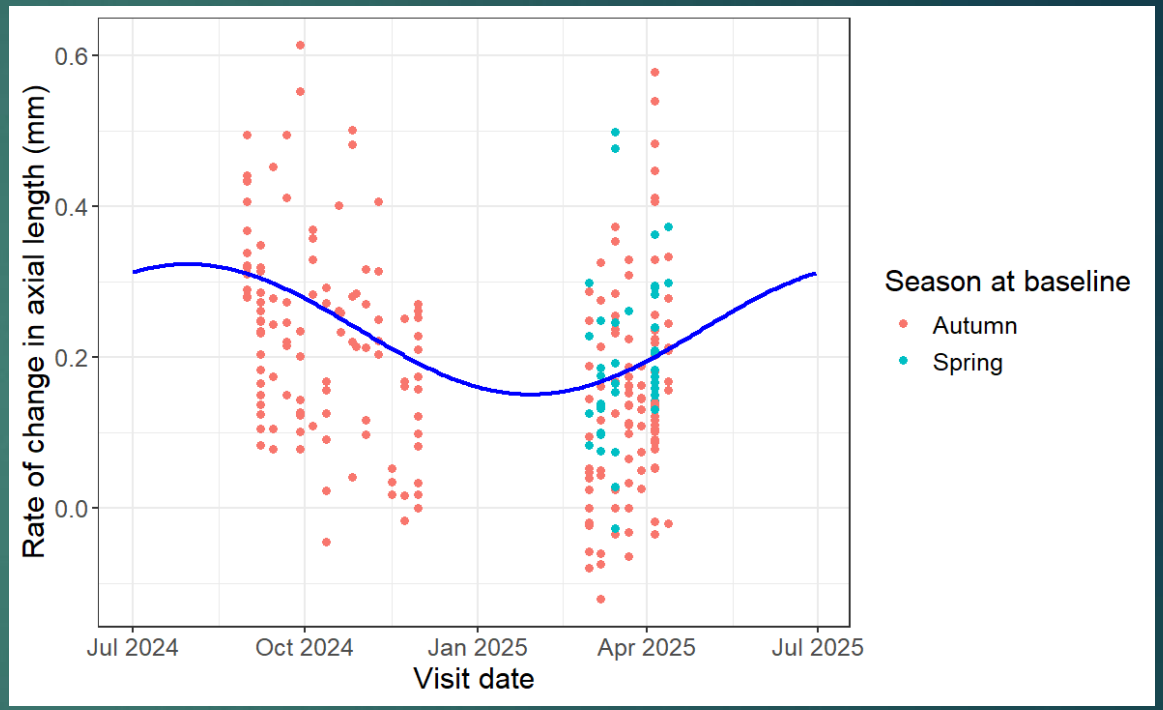


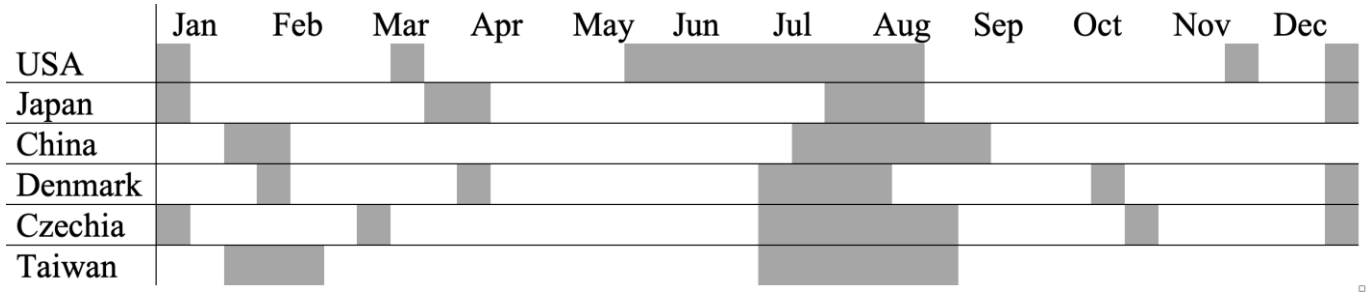
Figure 2: Rate of change of AL of Raine Gen-3 participants showing clear slowing of eye growth in summer. (G Lingham, 2025)

Myopia progression is affected by the seasons

- 11 of 12 studies demonstrated a statistically significant acceleration in either refractive error or axial elongation in winter compared to summer.
- This has been demonstrated most clearly in **children aged 6-13 yrs with myopia.**
- The only study which did not demonstrate a significant difference between seasons was that by Ulaganathan et al, likely due to it being a small and older sample population(18-30yrs).

The school calendar effect

Table 5: Illustration of timing of 2025 school holidays in study countries



Data sourced from: *Edarabia.com, PublicHolidaysGlobal and Expactica.com*

Table 6: Comparing length of summer break and progression of myopia

	Length of Sumer Break (Weeks)	Winter as % Summer	
Location		Refractive Error	Axial Length
Myopic School Children Only			
USA[12, 17]	11	297%	240%
Japan[14]	6	80%	121%
China (Guangzhou)[15]	8	250%	141%
Denmark[16]	6	123%	158%
General Population Sample of School Children			
Czechia[21, 22]	9	N/A	668%
Taiwan[23]	9	147%	N/A

Limitations of this review

- Unable to accurately compare study findings due to variations in their definition of the seasons and time between measurements
- Not all studies measured both axial length and refractive error making comparison difficult
- There was not enough data to ascertain whether there is any pattern between latitude and the difference in progression between summer and winter
- School calendars may have changed over the 25 years which studies were considered from

What's Next?

Although this is a review of the published literature, there are many studies that contain seasonal measurement which have not been published in detail (eg. other myopia treatment trials).

In addition, myopia treatment clinics will contain large datasets of RE and AL.

The next steps will be:

- Identify global databases with regular measurements where the seasonal changes can be analysed
- Collate data to identify trends which may only be evident in larger-scale data sets
- Consider how these parameters may be modifiable to help slow the progression of myopia in at risk patients

In Australia programs that increase children's outdoor time, specifically in winter may help prevent myopia.

References

- Fulk GW, Cyert LA, Parker DA. Seasonal variation in myopia progression and ocular elongation. Optom Vis Sci. 2002;79(1):46-51.
- Fujiwara M, Hasebe S, Nakanishi R, Tanigawa K, Ohtsuki H. Seasonal variation in myopia progression and axial elongation: an evaluation of Japanese children participating in a myopia control trial. Jpn J Ophthalmol. 2012;56(4):401-6.
- Donovan L, Sankaridurg P, Ho A, Chen X, Lin Z, Thomas V, et al. Myopia progression in Chinese children is slower in summer than in winter. Optom Vis Sci. 2012;89(8):1196-202.
- Cui D, Trier K, Munk Ribel-Madsen S. Effect of day length on eye growth, myopia progression, and change of corneal power in myopic children. Ophthalmology. 2013;120(5):1074-9.
- Gwiazda J, Deng L, Manny R, Norton TT, Group CS. Seasonal variations in the progression of myopia in children enrolled in the correction of myopia evaluation trial. Invest Ophthalmol Vis Sci. 2014;55(2):752-8.
- Ulaganathan S, Read SA, Collins MJ, Vincent SJ. Influence of seasons upon personal light exposure and longitudinal axial length changes in young adults. Acta Ophthalmol. 2019;97(2):e256-e65.
- 1Ding W, Zhao C, Li X, Lu W, Jiang D, Tian Y, et al. Seasonal variation in axial elongation in children with orthokeratology treatment. Ophthalmic Physiol Opt. 2025;45(3):877-82.
- Tang T, Li Y, Zhao M, Wang K. Seasonal Variation in the Effect of Controlling Myopia Progression Using Orthokeratology. Eye Contact Lens. 2025.
- Rusnak S, Salcman V, Hecova L, Kasl Z. Myopia Progression Risk: Seasonal and Lifestyle Variations in Axial Length Growth in Czech Children. J Ophthalmol. 2018;2018:5076454.
- Hecova L, Rusnak S, Salcman V, Cendelin J. Seasonal Variations in Ocular Axial Length Increase among Children in the Czech Republic. J Ophthalmol. 2023;2023:2592853.
- Tsai DC, Huang N, Fang SY, Hsu CC, Lin PY, Chen SY, et al. Seasonal variation of refractive error change among young schoolchildren in a population-based cohort study in Taipei. Br J Ophthalmol. 2019;103(3):343-8.
- Lee SS, Lingham G, Blaszkowska M, Sanfilippo PG, Koay A, et al. Low-concentration atropine eyedrops for myopia control in a multi-racial cohort of Australian children: A randomised clinical trial. Clin Exp Ophthalmol. 2022 Dec;50(9):1001-1012. doi: 10.1111/ceo.14148. Epub 2022 Sep 9. PMID: 36054556; PMCID: PMC10086806.

Thank you!

RANZCO Global Eye Health and International Agency for the Prevention of Blindness Conference, Hobart, March 8th 2026

Seasonal Variation in IOP

- There area number of studies demonstrating that IOP is significantly higher on average in winter than summer in patients with ocular pathology[34-40] and healthy patients[41-43].
- Mendelian Randomisation studies have demonstrated that there is a causal relationship between higher IOP and the development of myopia[45-47].
- A larger-scale study to examine the link between refractive error/axial length and IOP throughout the seasons would be informative.

The effect of latitude

Mean progression	Fulk et al, 2002[11]		Fujiwara et al, 2012[15]		Donovan et al, 2013[13]		Cui et al, 2013[16]		Gwiazda et al, 2014[13]	
	RE	AL	RE	AL	RE	AL	RE	AL	RE	AL
Summer as % of winter	35.48	41.67	125	80.59	58.49	70.83	81.25	63.16	40	N/A
Latitude	30.3298		34.66		23.1291		55.67		36.4	

Table 4: Summer as % of Winter in myopic participants compared to latitude

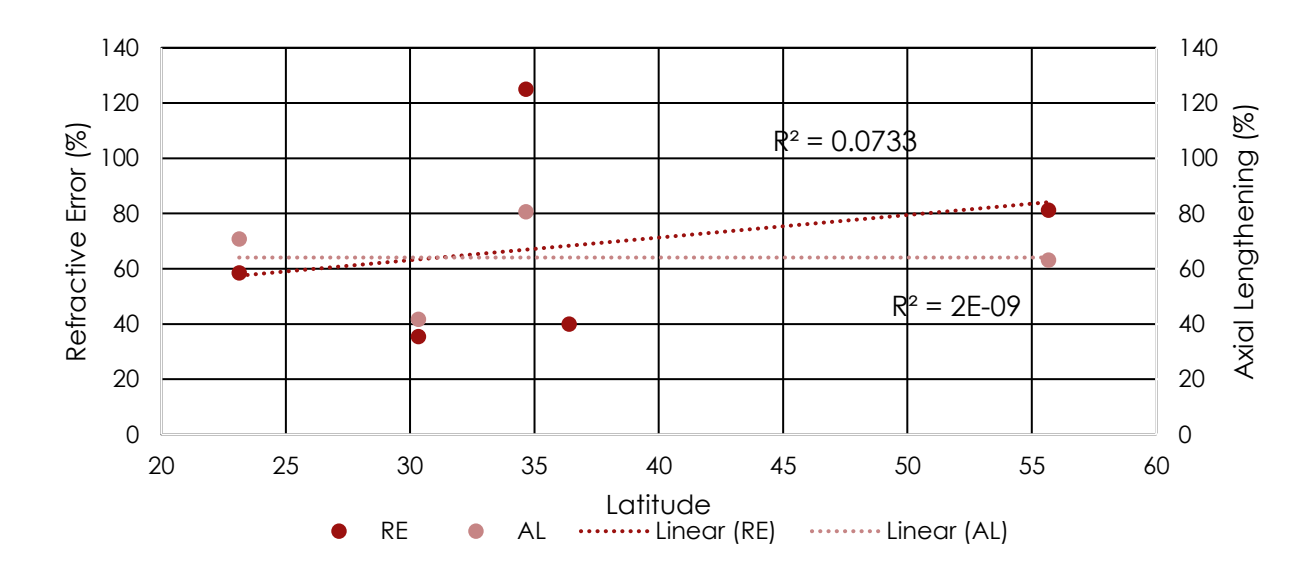


Figure 1: Summer as % of winter in myopic participants versus latitude showing no clear correlation.