

Childhood Myopia and Ayurvedic Preventive Ophthalmology, Integrating Outdoor Exposure, Dincharya, and Ocular Development: A Scoping Review

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KEYWORDS

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Abstract

Background. Childhood myopia has reached pandemic proportions, with a global prevalence rising from 24.3% in 1990 to 35.8% in 2023. Projections indicate that by 2050, over 740 million children will be myopic. Conventional interventions target disease progression rather than primary prevention. Ayurveda offers a comprehensive preventive framework, *Dincharya* (daily regimen), specifically designed to preserve visual health.

Methods. A scoping review of peer-reviewed literature (PubMed, Scopus, EMBASE, Cochrane Library; inception to February 2025) was conducted using the keywords childhood myopia, outdoor time, dopamine, Ayurveda, *Dincharya*, *Netra Tarpana*, *Triphala*, *Nasya*, and *Padabhyanga*. Only original research, systematic reviews, and meta-analyses were included.

Results. A dose-response meta-analysis showed-- that increasing outdoor time to 16.3 hours/week reduced myopia onset risk by 53% (OR = 0.53; 95% CI, 0.34–0.82). This effect is mediated by intensity-dependent retinal dopamine release. Myopic children also exhibit lower nocturnal melatonin levels and delayed circadian timing. Ayurveda's *Dincharya* practices *Netra Prakshalana* (*Triphala* eyewash), *Nasya* (*Anu Taila*), *Padabhyanga* (foot massage) and *Netra Tarpana* (medicated ghee retention) show evidence of antioxidant, neuro-nourishing and ocular-surface stabilizing actions.

Conclusions. The integration of structured outdoor exposure with Ayurvedic *Dincharya* creates a synergistic, low-cost, and scalable primary prevention strategy for childhood myopia. This integrative approach addresses both environmental triggers (inadequate light) and lifestyle deficits (irregular sleep, circadian misalignment, and digital eye strain).

1. INTRODUCTION

Myopia is no longer a benign refractive inconvenience but a global public health concern [1]. A comprehensive systematic

review and meta-analysis- of 276 studies involving 5.4 million children from 50 countries reported that the pooled

prevalence of childhood myopia increased from 24.3% in 1990 to 35.8% in 2023 [2]. Projections indicate a further increase to 39.8% by 2050, with East Asia already exceeding 80–90% in adolescent populations [3]. The COVID-19 pandemic accelerated this trend due to widespread lockdowns, school closures, and an unprecedented shift to digital learning [4].

Conventional myopia management relies on optical corrections (spectacles, contact lenses), pharmacological agents (low-dose- atropine), and environmental advice [5]. However, these measures predominantly slow the progression of myopia- rather than prevent its onset in healthy children [6]. Moreover, they do not address the fundamental mismatch between modern indoor lifestyles and the ocular development program that evolved under natural light [7].

Ayurveda, the traditional medical system of India, has maintained an unbroken lineage of preventive ophthalmology for over two millennia [8]. The daily regimen *Dincharya* includes specific practices explicitly described as *Chakshushya* (vision-promoting-) [9]. These include *netra prakshalana* (ocular washing), *nasya* (nasal medication), *padabhyanga* (foot massage), and *netra tarpana* (ocular rejuvenation) [10]. The

Ayurvedic conceptual framework views vision not as an isolated function but as an outcome of systemic balance (*tridosha*), metabolic fire (*agni*), circadian harmony, and tissue nourishment (*rasayana*) [11]. Classical Ayurvedic lexicons, such as *Bhavaprakasha* and *Rajanighantu*, enumerate dozens of *chakshushya* herbs and daily routines [32,33]. This review examines whether the principles of Ayurvedic *dincharya* can be integrated with modern evidence on outdoor light exposure to develop a unified, mechanism-based- preventive strategy for childhood myopia.

2. METHODS

A scoping review was conducted according to the PRISMA Extension for Scoping Reviews. PubMed, Scopus, EMBASE, the Cochrane Library, and the Ayush Research Portal were searched from inception to February 2025 for relevant studies. The search terms included (“myopia” OR “refractive error”) AND (“child” OR “adolescent”) combined with (“outdoor time” OR “light exposure” OR “dopamine”) OR (“Ayurveda” OR “dincharya” OR “netra tarpana” OR “triphala” OR “nasya” OR “padabhyanga”). Only original research, systematic reviews, meta-analyses-, and clinical trials published in English were

included. We excluded case reports, commentaries, and conference abstracts. Reference lists of included articles were manually screened.

3. RESULTS

3.1. The Outdoor-Light–Dopamine Axis

The protective effect of outdoor time against myopia onset is one of the most consistent findings in contemporary ophthalmology. A meta-analysis- of 12,922 children (6–16 years) reported that comparing the highest versus lowest outdoor exposure yielded an odds ratio of 0.53 (95% CI, 0.34–0.82) for myopia onset. The dose-response- relationship is nonlinear: increasing outdoor time from 3.5 to 7, 16.3, and 27 h/week reduced the onset risk by 20%, 53%, and 69%, respectively [12]. A second meta-analysis- found that clinical trials using outdoor time as an intervention reduced myopic shift by –0.30 D after three years compared to controls [13]. Importantly, outdoor time only slows progression in pre-myopic- children, not in those who are already myopic [6].

Retinal dopamine is a biological mediator. In a chick lens-induced- myopia model, bright light (20,000–40,000 lx) inhibited axial elongation in an intensity-dependent- manner, and this protection was

significantly reduced by a D2-like dopamine receptor antagonist [14]. Retinal dopamine levels showed a parallel intensity-dependent- increase. In mice, dopaminergic cell activation and light-induced- dopamine release is driven by classical photoreceptors and are essential for normal emmetropization [15].

Circadian regulation adds another layer to this process. Myopic children have been shown to exhibit both lower nocturnal melatonin output and delayed melatonin circadian timing compared to normal-sighted- peers [16]. The dopamine–melatonin axis integrates daytime light (dopamine, stop signal) and nighttime darkness (melatonin, scleral remodelling guidance) [17]. Disruption of this axis through inadequate daytime light, evening blue light- exposure, or irregular sleep may independently drive myopic axial elongation [16,17].

3.2. Ayurvedic Dincharya for Ocular Health

Ayurvedic dincharya comprises a sequence of daily activities explicitly prescribed to preserve the vision [8,9]. Table 1 summarizes the key practices, their classical descriptions, and modern mechanistic correlates.

Table 1. Key Dincharya Practices for Preventive Ophthalmology

Practice	Classical description	Modern mechanistic correlate	Key evidence
Netra prakshalana (eye wash)	Daily washing with Triphala kwath, removes <i>mala</i> (waste) and soothes <i>pitta</i> [10]	Reduced oxidative load; antibacterial activity against ocular pathogens; increased tear stability [18]	Triphala extract shows dose-dependent inhibition of <i>S. pneumoniae</i> , <i>S. aureus</i> ; safe in bacterial conjunctivitis [18]
Anjana (collyrium)	Application of medicinal paste to inner eyelid; clears <i>kapha</i> from ocular channels [11]	Mechanical clearance of debris; mild neuro-stimulation	No high-quality RCTs, but widely used in South Asian pediatric eye care [10]
Nasya (nasal medication)	Instillation of Anu taila or Shadbindu taila via nostrils; removes <i>kapha</i> from <i>urdhvajatrugata</i> [9]	Direct nose-to-brain pathway for neuro-nourishing oils; modulates circadian inputs via olfactory-hypothalamic connections [19]	Open trials show reduction in digital eye strain symptoms and possible slowing of myopia progression [19]

Padabhyanga (foot massage)	Massage of soles with warm oil before sleep; described as <i>chakshushya</i> [8]	Reflex zones corresponding to ocular structures; improves sleep quality and circadian alignment [20]	Observational studies report improved visual acuity in refractive error cases [20]
Netra tarpana (ocular retention)	Retention of medicated ghee (e.g., Triphala ghrita) within a dough-dam over closed eyes; classic <i>kriyakalpa</i> for rejuvenation [21]	Deep penetration of lipid-soluble antioxidants; stabilization of tear film; reduction of ciliary muscle spasm [21]	Clinical studies report superior symptomatic relief for dry eye and computer vision syndrome compared to artificial tears [21]
Trataka (yogic gazing)	Unblinking gaze at a fixed point (e.g., candle flame); trains both accommodation and attention [22]	Improves accommodative facility; reduces near-work fatigue [22]	Small trials show improvement in visual acuity in myopic and hypermetropic children after 12 weeks [22]

3.3. Herbal Formulations with Ophthalmic Evidence

Triphala: Equal parts of *Terminalia chebula*, *Terminalia bellirica* and *Emblica officinalis* is described in Ayurveda as *chakshushya* (vision-promoting)

and *rasayana* (rejuvenative) [18]. A narrative review identified 46 articles, including 15 clinical studies, that support its use in various ocular diseases [18].

Pre-clinically, Triphala extracts exhibit antioxidant, anti-inflammatory-, antibacterial, and anticataract activities [23]. A 21-day treatment with Triphala decoction was safe and effective for bacterial conjunctivitis, with microbiological clearance comparable to that of standard antibiotics [18].

Saptamrita Lauha, a herbo-mineral formulation, has been evaluated in clinical trials for simple myopia. A randomized controlled trial (n = 60, age 8–30 years) comparing Saptamrita Lauha (250 mg twice daily with honey and ghee) versus yoga therapy found no significant reduction in visual acuity or refraction, although some associated symptoms were improved [24]. The negative finding on primary outcomes underscores the need for larger, well-designed- trials [24].

3.4. Clinical Studies of Ayurvedic Interventions for Myopia

A randomized open-label- trial compared *pratimarsha nasya* (low-dose- daily nasal medication) plus *aschyotana* (eye drops) versus *marsha*

nasya (therapeutic dose) plus *Tarpana* in simple myopia (n = 60, age 8–40 years) [19]. Both groups showed improvement in symptoms, with the *nasya-plus-tarpana* arm tending toward better stabilization of the refractive error [19]. A case study reported that combined Triphala administered orally (3 g/day) with *Nasya* and *Tarpana* produced 60% relief in *avyaktadarshana* (indistinct vision), and 53.3% of patients achieved 100% visual efficacy [25]. A recent single case study reported significant subjective improvement in a myopic child after a 45-day course of combined Ayurvedic therapies, including Triphala ghrita and *nasya* [34].

A comparative study of Triphala Rasayana versus Saptamrita Lauha in myopia is currently registered in the Clinical Trials Registry of India (CTRI/2025/05/089217) [26]. A randomized controlled trial of Shadang Kwath Vati for pediatric myopia (CTRI/2025/04/088923) is also underway [27]. Table 2 summarizes the clinical evidence for Ayurvedic interventions in childhood myopia.

Table 2. Summary of Clinical Evidence for Ayurvedic Interventions in Childhood Myopia

Intervention	Design	Population	Key findings	Limitations
Saptamrita Lauha vs. yoga therapy	RCT (n = 60)	Myopia 8–30 years	No significant change in refraction or VA	Small sample; short duration (60 days) [24]
Pratimarsha nasya + aschyotana vs. marsha nasya + tarpana	Open-label RCT (n = 60)	Simple myopia 8–40 years	Symptom improvement; trend toward stabilization	No sham control [19]
Triphala rasayana (oral) + anjana	Non-randomized (n = 30)	Simple myopia	60% relief in indistinct vision; 53% achieved 100% visual efficacy	Single arm; no blinding [25]
Triphala Ghrita tarpana + eye exercises	RCT (n = 80)	Simple myopia 12–25 years	Improved symptoms and accommodative facility	Ongoing; final results pending [28]
Padabhyanga (foot massage)	Observational (n = 45)	Refractive errors	Subjective improvement in visual acuity and sleep	Small; no objective refraction change [20]

4. DISCUSSION

This review identifies a convergence between modern myopia research and Ayurvedic preventive ophthalmology that

has not been systematically articulated previously [29]. The common pathway is the regulation of ocular growth through

light-driven- dopamine release and circadian alignment [16,17]. Both systems recognize that visual health is not a static property but a dynamic process shaped by daily interactions with the environment [7,8].

4.1. Strengthening the Dopamine–Melatonin Axis through Dincharya

Modern myopia control has focused almost exclusively on the dopamine arm, increasing outdoor light. However, this approach has three inherent limitations. First, its effect is dose-dependent- and nonlinear, requiring approximately two hours of daily outdoor time for meaningful protection [12]. In densely populated urban environments and during winter months, this is often unattainable [7]. Second, outdoor time only slows progression in pre-myopic- eyes; once myopia is established, it does not arrest further axial elongation [6]. Third, it neglects the melatonin arm [16,17].

Ayurvedic *Dincharya* addresses these limitations. *Nasya* with medicated oils, such as *Anu taila* or *Shadbindu taila*, is administered in the morning and evening, thereby providing two daily inputs that may influence circadian timing via olfactory projections to the suprachiasmatic nucleus [19,30]. *Padabhyanga*, performed at night before sleep, is explicitly described

as *nidrakara* (sleep-inducing-) and *drishtiprasadana* (vision-clarifying-) [20]. By improving sleep quality and regularity, *padabhyanga* may help restore the nocturnal melatonin peak, which is blunted in myopic children [16,20]. *Netra tarpana*, typically performed in courses, is a deep ocular tissue therapy that may reduce chronic ciliary muscle spasms and oxidative damage, addressing the “wearing-out” of the accommodative apparatus that accompanies prolonged near work [9,21].

No single Ayurvedic practice can replace outdoor activities. However, when layered onto a foundation of daily outdoor exposure, the *dincharya* practices appear to target the remaining modifiable risk factors that outdoor time alone cannot address: sleep disruption, circadian misalignment, digital eye strain, and oxidative stress [29,17].

4.2. A Proposed Integrative Preventive Model

Figure 1 presents a conceptual framework that integrates modern and ayurvedic pathways. The central proposal is that effective primary prevention of childhood myopia requires simultaneous activation of the dopamine arm (daytime outdoor light) and restoration of the melatonin arm (nighttime sleep and circadian

regularity) [16,17,29]. Ayurvedic practices can support both arms.

- **Dopamine arm:** Outdoor time ($\geq 11,000$ lx for ≥ 40 min/day) directly stimulates retinal dopamine [14]. Triphala's antioxidant and anti-inflammatory actions may reduce oxidative stress that otherwise blunts dopamine signalling [18,23].
- **Melatonin arm:** Nasya (morning) may help entrain the suprachiasmatic nucleus [19,30];

Padabhyanga (evening) and avoidance of evening blue light facilitate melatonin onset [16,20]; *Netra tarpana* (periodic) addresses ocular surface inflammation that can disrupt local circadian clocks [21].

- **Near-work- resilience:** Trataka and eye exercises (*netra vyayama*) train the accommodative facility and reduce the sustained ciliary contraction that exacerbates myopic drift [22].

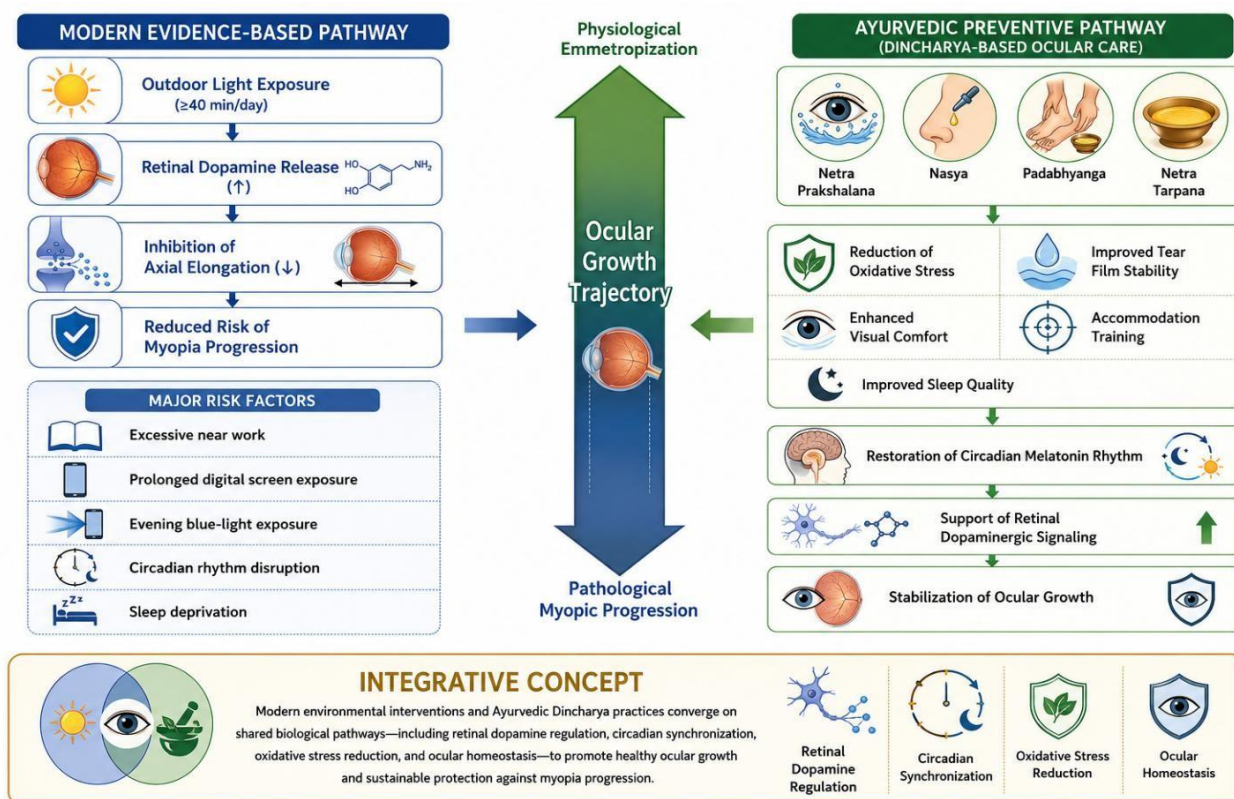


Figure 1: Integrative Model for Primary Prevention of Childhood Myopia

4.3. Limitations of the Current Evidence

The primary limitation of the Ayurvedic evidence base is the paucity of large,

randomized, double-blind-, sham-controlled- trials [29,31]. Most published

studies are open-label-, non-randomized-, or small case series [19,24,25]. Outcome measures are often subjective symptom scores rather than objective axial length or cycloplegic refraction measurements [24,28]. There is also a risk of publication bias favoring positive results in this study. [31].

However, the absence of high-level- evidence does not invalidate the underlying biological plausibility or safety of these practices. All the dincharya practices described here are non-invasive, low-cost-, and have been used safely for centuries [8,9]. The question is not whether they cause harm, but whether they confer additional benefits when added to evidence-based- outdoor time recommendations [29]. This question can and should be answered by rigorous pragmatic trials [31].

4.4. Implications for Policy and Practice

In clinical practice, an integrated prescription can be formulated as follows [10,29]:

1. **Daily outdoor time:** Minimum 60–90 minutes of outdoor activity, preferably in the morning hours when the light intensity is $\geq 10,000$ lx [12,14].
2. **Morning Nasya:** One drop of Anu taila in each nostril after brushing teeth [19].
3. **Evening padabhyanga:** Five-minute- foot massage with warm sesame oil before bedtime [20].
4. **Weekly netra prakshalana:** Triphala eyewash once a week [18].
5. **Twice yearly- netra tarpana:** A 7-day course of medicated ghee retention, particularly before periods of heavy near-work [21].
6. **Trataka training:** Five minutes of candle-gazing- daily to improve accommodative facility [22].

For public health policy, this integrated approach offers a scalable, low-technology- strategy that can be implemented in schools and communities, especially in low-- and middle-income- countries where pharmaceutical and optical myopia control are unaffordable [5,7]. Traditional Ayurvedic ophthalmology has long advocated universal preventive measures rather than expensive interventions, aligning with modern public health principles [8,32].

4.5. Future Research Directions

Priority research areas include [29,31]

- Pragmatic cluster randomized- trials comparing standard outdoor advice versus outdoor advice plus the dincharya package, with axial length and circadian phase as primary outcomes.
- Mechanistic studies measured salivary melatonin profiles and urinary 6-sulfatoxymelatonin in children before and after padabhyanga/nasya interventions [16,20].
- Dose-finding- studies for Triphala eyewash and netra tarpana frequency [18,21].
- Pharmacokinetic studies of Triphala and Anu tail constituents in ocular tissues after Nasya administration [19].

5. CONCLUSION

Childhood myopia has become a pandemic driven by indoor lifestyles, insufficient daylight exposure, and disrupted circadian rhythms. Contemporary prevention strategies have focused nearly exclusively on increasing outdoor time, overlooking the complementary roles of sleep quality, circadian regularity, and ocular tissue nourishment. Ayurvedic dincharya offers a codified set of daily practices that explicitly

target neglected pathways. Integrating structured outdoor light exposure with selected dincharya practices, particularly nasya, padabhyanga, netra tarpana, and Triphala-based netra prakshalana, creates a synergistic, low-cost-, scalable primary prevention strategy. This integrative model aligns with the emerging understanding of the dopamine–melatonin axis in ocular development and deserves urgent investigation through rigorous clinical trials.

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