Review: Myopia control strategies recommendations from the 2018 WHO/IAPB/BHVI Meeting on Myopia

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ABSTRACT

Myopia is a major public health problem, particularly in East Asia. In this summary report, we present key findings and recommendations on strategies for myopia control discussed during the meeting jointly organised by the WHO Regional Office for the Western Pacific, the International Agency for the Prevention of Blindness and the Brien Holden Vision Institute. First, myopia prevalence was reported to be increasing, with up to 80% of junior school students with myopia in East Asia. However, common challenges in implementing myopia control strategies on a national level included lack of school screening programme, and paucity of accurate prevalence data. Second, there continues to be broad public misconception about myopia and myopia control, including lack of parental awareness and resistance to wearing spectacles. Third, best practices for myopia management were shared, and recommendations for policy implementation are presented in this review. Key recommendations from this meeting include increased public education to raise parent and teacher awareness; encouragement of increased outdoor time of 2–3 hours per day for schoolchildren—as a practical public health intervention that has been shown to potentially reduce onset and progression of myopia. Governments and non-governmental organisations are encouraged to collaborate, especially education and health ministries to develop national myopia prevention programme. Lastly, it is important to emphasise that the key recommendations, such as increasing outdoor time for schoolchildren, are specific for East Asian nations in the Western Pacific region and may not be entirely applicable for Western nations.

INTRODUCTION

Myopia is one of the most common ocular conditions in the world and a major cause of avoidable visual impairment if uncorrected. Globally, the reported prevalence of childhood myopia ranges widely by regions and ethnicities, from less than 3% in Africa (Ethiopia)[1] to around 90% in Asia (Hong Kong).[2] In general, the highest prevalence of myopia exists in East Asia, with up to 80% of junior school students with myopia,[3] of which up to 20% have high myopia in mainland China,[4 5] South Korea,[6] Japan[7] and Singapore.[8] The projected increase in high myopia, and complications associated with pathological myopia, has led to high myopia being recognised as a potential public health problem with a significant economic burden.[9]

In 2015, a 'Global Scientific Meeting on Myopia' was convened by the WHO and the Brien Holden Vision Institute (BHVI) with an aim to reach consensus on definitions of myopia and pathological consequences of high myopia.[10] Recommendations included cycloplegia to be employed in epidemiological studies in children (under 18 years); while behaviours and agents that might decrease progression were itemised, and pathological consequences of a failure to control progression were detailed.[10] The working group also cautioned against undercorrection of myopia in the face of increasing evidence that such practice might increase myopia progression.

In 2018, a follow-up meeting was organised by the WHO Regional Office for the Western Pacific region (WPRO), the International Agency of Prevention of Blindness and BHVI in Singapore to discuss public health strategies and interventions with an aim for recommendations specifically for myopia control in the region. The aims of this meeting were to (a) review current knowledge on myopia control strategies; (b) gain an understanding of the prevalence of myopia and the awareness of its burden in various countries with any existing myopia management strategies and (c) to discuss and reach consensus on recommendations to raise awareness of the burden of myopia and implementation of public health interventions for myopia control. This report summaries the findings and recommendations, which are shown in table 1 (full detailed minutes and outcomes of this meeting are available on request with corresponding author). It is important to emphasise that these recommendations are specific for nations in the WPRO, and may not be entirely applicable for Western nations.

Evidence on myopia control strategies

The evidence for various myopia control strategies that may be implemented by member states were discussed, with considerations on the practicality of implementation by member states (figure 1).

Environmental interventions

Two common environmental interventions were discussed: outdoor activities and near work activity. As reported in various epidemiological studies,[11] and notably in some major studies such as the Sydney Myopia Study, Orinda study and the Singapore Cohort Study of Risk Factors for Myopia,[12–14] increased time spent outdoors was positively associated with preventing the onset of myopia[15] which

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Table 1 Reports from member states from the Western Pacific Region of the WHO

Country*	Estimated myopia prevalence	National coordinated myopia screening Programme	Barriers to implementation of new programme	Future developments
Australia	3%	None	Lack of awareness School involvement needed—vision screening and more outdoor activities	Promote awareness and public education
Cambodia	2.5% to 13.7%	Vision screening	Lack of awareness Cultural barriers	Public education
Korea	53.7%	Vision screening	Lack of outdoor activities being promoted	Myopia control and recommendations for evidence-based intervention
Laos	14.3%	None	No surveillance programme with lack of data	Implementation of surveillance programme
Malaysia	34.4%	Vision screening	Lack of awareness Limited resources	Integrating primary eye care programme in health services
Mongolia	41.7%	Vision screening	Lack of knowledge and resources	Integrating eye health programme in health services
Vietnam	Unavailable	Vision screening	Lack of awareness Limited resources	Training of eye care professionals in myopia understanding and control

*Countries from member states from the WHO Western Pacific Region participating in the WHO Meeting in 2018. Two countries are discussed in detail as case studies and not included in this table.

indication was confirmed by evidence from a number of clinical trials. In a randomised controlled trial conducted in Guangzhou, an additional 40 min of outdoor time reduced the incidence of myopia by 23%.[16] A meta-analysis[17] concluded that every additional hour of outdoor time per week appeared to decrease the odds of myopia by 2%. A school-based programme conducted in Taiwan showed that children who spent 11 hours or more outdoors a week had a 54% lower risk of myopia progression than children who did not, and this was achieved even with moderate light intensities such as in hallways or under a tree.[18]

The evidence in support for near work activity as a risk factor for myopia (a prevailing concept widely held) has not been entirely convincing.[19] Huang *et al* conducted a meta-analysis comprising 12 cohort studies and 15 cross-sectional studies and found the odds of myopia increase by 2% for every one diopter-hour more of near work per week.[20] However, many questions remain unanswered with regard to near work activity as a risk factor for myopia prevalence and progression.[21] Some studies have observed that the *type* of near work might be more important than the total duration, while others have found continuous reading of more than 30–45 min without a break more detrimental than the total duration of near work.[22 23]

Spectacle lenses

Initially observed to impede the progression of myopia in animal studies, under-correction was considered to induce myopic defocus and therefore reduce the stimulus for progression. However, in human clinical trials, under-correction was found to have conflicting results ranging from decrease in myopia progression to worsened progression.[24–26] In view of these conflicting results, under-correction of myopic refractive error as an intervention for slowing myopia progression is still controversial.

Bifocal or multifocal spectacles: In myopic children, accommodative lag during near work was thought to result in hyperopic defocus that then triggered axial elongation. It was considered that progressive addition lenses (PAL) reduce the accommodative lag and these lenses were therefore extensively investigated as an intervention for myopia. Although evidence indicates that

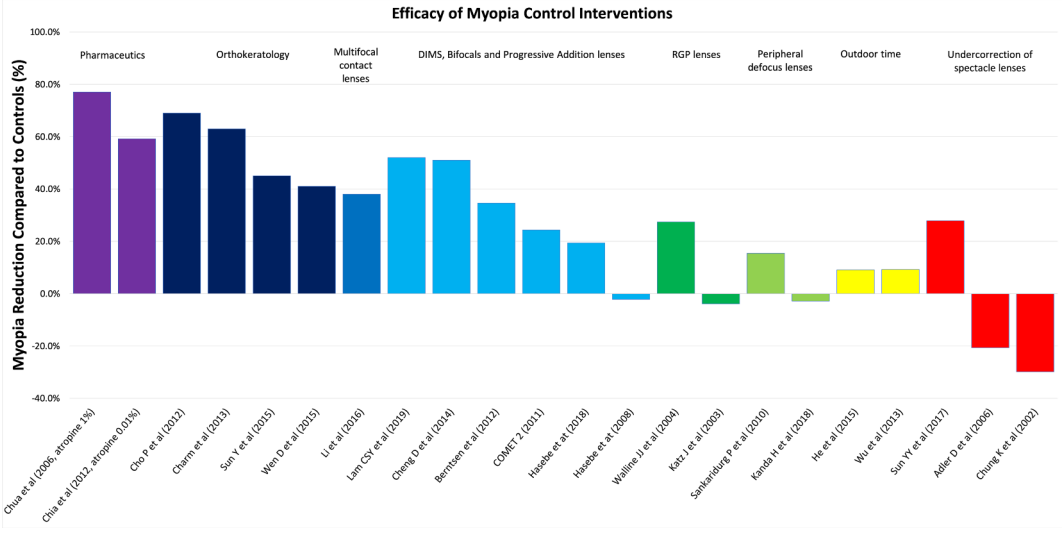

Figure 1 Summary of some of the key studies that report the efficacy of various strategies for myopia control discussed at the 2018 WHO Western Pacific Region Meeting on Myopia.

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PAL slow myopia progression, the reduction in progression compared with single vision spectacles was clinically insignificant (less than 0.2D per year).[27–34] Bifocal lenses, both with and without base-in prism, have been reported to slow myopia progression by 39%–51% over 3 years.[35]

Peripheral myopic defocus glasses: Sankaridurg *et al* reported no significant effect on myopia progression with any of three novel peripheral defocus spectacle lenses with the exception of a single design slowing myopia by 30% in a subgroup of younger children with parental myopia.[36] A randomised controlled trial of peripheral defocus spectacle lenses similarly found no effect on myopia reduction in Japanese children.[37] The Defocus Incorporated Multiple Segments spectacle lens has multiple, small segments incorporating relatively positive power while providing clear vision centrally. This lens has been reported to slow myopia progression by nearly 60% in children compared with single vision lenses.[38] These are promising results, but require validation in further studies.

Contact lenses

Rigid gas permeable (RGP) contact lenses: Two randomised clinical trials reported that RGP contact lenses did not retard axial eye growth.[39 40]

Orthokeratology: Overnight orthokeratology (Ortho-K) lenses have shown efficacy in inhibiting myopia progression with studies reporting a 32%–63% reduction in the rate of axial elongation over 5 years in East Asian children aged from 7 to 16 years.[41–47] However, efficacy might decrease over time,[44 48] with 7%–12% of children having no effect in slowing myopia.[43] The concern over the risk of infective keratitis has hampered widespread adoption of overnight Ortho-K use for myopia control in children.[49] It remains unclear if there is rebound on discontinuation with one study indicating that there might be some rebound.[50] Encouragingly, more recent evidence indicates that combination strategies, that is, Ortho-K and low concentration atropine (0.01%) eye drops may be more effective in slowing axial elongation over 12 months than Ortho-K treatment alone.[51]

Soft multifocal-like contact lenses: Contact lenses are a more cosmetically acceptable option over spectacle lenses, and are more convenient for active children, especially during sports.[52 53] In addition, the fitting procedures of soft bifocal contact lenses are relatively simple compared with Ortho-K; and these lenses may be a safer option, as there is no overnight use, commonly on a daily disposable basis. However, the risk of infection from soft contact lens still exists, and the relative ease of use may decrease the need for parental supervision and possibly mask early signs of infection. Soft bifocal and multifocal contact lenses were shown to slow myopia by 25%–50% in terms of spherical equivalent and 27%–32% for axial length in children aged 8–16 of various ethnicities over a period of 24 months; a treatment effect comparable to that of Ortho-K lenses.[54 55] The Food and Drug Administration (FDA) has recently granted regulatory approval for the use of the MiSight dual focus contact lens (CooperVision, Pleasanton, CA, USA) for slowing myopia progression in children, and currently undergoing trials for use around several centres in Asia.

Pharmacological intervention

Pharmacological intervention for myopia control using high-dose atropine (ie, 0.5% or 1.0%) slowed myopia progression by more than 70% in children aged 6–13 years over 1–2 years,[50 56–59] but this intervention was associated with side effects including pupil dilation, glare and blurred vision. Lower doses (0.1% or less) of atropine produce fewer side effects and can decrease myopia progression by 30%–60%.[58] At higher doses (0.5% and 0.1%) and in younger children, a rebound in myopia progression was observed if atropine were stopped abruptly.[60 61] However, it is noteworthy that the FDA has not granted regulatory approval for the use of any pharmacological agents for myopia.

It was acknowledged by member states that from a public health perspective, policies to change environmental factors may have more impact on the population level, compared with optical or pharmacological interventions, which have may have more significant impact on the individual.

State of myopia and current practices on myopia control strategies in the WPRO

Table 1 summarises the myopia prevalence, current state of awareness and policies to address the myopia epidemic, and challenges in tackling the burden presented by some of the member states. In summary, prevalence rates were not always well documented and the lack of accurate data capture was highlighted as common barrier for studying the problem in depth in many countries.

The member states reported several challenges in implementing strategies to stem the rising burden. For example, lack of screening practices either at school or pre-school (Mongolia and Cambodia) and lack of accurate prevalence data (Mongolia, Cambodia and Vietnam) precluded understanding the extent of the problem. Lack of parental and teacher awareness, and misconceptions about myopia correction, and even resistance to wearing spectacles (Cambodia) were also commonly shared. Other misconceptions reported were that myopia can be 'cured' with spectacles or with laser refractive surgery (eg, laser in-situ keratomileusis). Most shared a lack of understanding of how high myopia is associated with a higher risk of pathological myopia and visual impairment. It was recognised that more efforts are required in developing myopia treatments and engaging more eye care practitioners to detect early complications of myopia.

In view of increasing myopia prevalence, there was consensus by member states on the urgency to have a comprehensive public health programme aimed at delaying myopia onset and progression. A recent study into global productivity loss due to vision impairment from myopic macular degeneration and uncorrected myopia estimated US$250 billion in lost productivity.[62] This study at least offers an indication of the scale of the problem in direct and indirect costs. However, in relation to myopia control, even in many high-income countries, Universal Health Coverage and especially health insurance schemes do not cover spectacle correction. It is likely WHO will use spectacle coverage rate as one of the tracer indicators of Universal Health Coverage, which will lead to increased attention on myopia and the current gaps in spectacle coverage.

Finally, a common barrier to implementation of myopia control strategies was reported as a lack of coordination and cooperation between key government ministries (eg, education and health) in working together for a common public health programme. This barrier limits the ability of member states to introduce broad public health programme such as screening programme in school or increasing outdoor time for children to reduce myopia onset. As such, strategies to increase outdoors time have been hard to implement in many member state countries. Another common barrier comes from parents who are concerned that increased outdoors time may affect time for studies, and teachers may not be supported in encouraging outdoor learning and play. One proffered strategy was to emphasise the other potential benefits

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of outdoor activities such as reducing childhood obesity, and improved mental health. It may also be useful to share successful case studies, such as in Singapore, where the Early Childhood Development Agency under the Ministry of Education has mandated, through licensing, that preschool children receive up to 1 hour of outdoor time daily.[63] Several case studies with successful public health strategies were discussed. Similarities and contrast between two member states are presented here.

China

While myopia has been identified as a major public health issue in China, with many studies reporting myopia rates of more than 50% and high myopia rates of more than 20% in students living in urban cities such as Shanghai,[64] they do not yet have a nationally driven programme specific for myopia control. Thus in August 2018, eight departments of the Chinese State government, including the Ministry of Education and National Health Commission, set targets to reduce myopia among children through a multi-sector approach in China.[65]

Based on published evidence, discussion panels comprising policy makers, teachers and community eye care practitioners were conducted with a focus on changes in behaviour such as increasing outdoors time and parent education.[66] An example of an integrated community programme is a school-based screening of 1.5 million children per year in Shanxi, China that coordinated assessments with real-time data entry by teachers and community eye care practitioners. A 5-year screening programme, from June 2013 to May 2018, at over 2000 screening sites, screened 1.5 million students annually and referred 200 000 (unpublished data presented at meeting by WHO member state). Optical shops under this programme also provided low cost glasses, with discounts within 3 months of referral. This programme is an example of a successful coordinated effort to screen vast numbers of children and to engage children, parents and teachers in active participation and responsibility for children's eye health. Even with this concerted effort however, it was found that less than 50% of parents followed up referrals for spectacles, giving an indication of efforts required to improve parental education about detecting myopia, refractive error correction and reducing myopia progression.

Singapore

Public health policies to control myopia have been introduced in Singapore as early as late 1970s and 1980s.[67] It has been estimated that by 2050, 80% of Singaporeans 80-year olds or older will be myopic.[68] Several studies conducted in Singapore have supported the idea that more time outdoors will prevent myopia progression.[14] Moreover, the use of outdoor activity diaries, questionnaires and light monitors have suggested Singaporean children spend a large amount of time in very low light levels.[69] A barrier to remedying this situation is the educational pressure that leads to children spending more time on near work and less time outdoors. As such, the Singapore Health Promotion Board encourages families to spend time together outdoors, participating in outdoor physical activities that achieve a number of public health goals at once.[70] Recommendations for outdoor time to prevent myopia include 2–3 hours outside every day. Increased outdoors physical activity may also reduce the risk of childhood obesity and improved mental health in children. In fact, the early childhood development agency in Singapore requires 30–60 minutes of outdoor learning in order for early childhood schools such as kindergartens to attain a license. There are current discussions to increase this to 2 hours per day. In this programme, a holistic approach is advocated (even encompassing diet and sleep) to make improvements in child health from a public health perspective.

Box 1 Summary of key recommendations from various stakeholders including governments, NGOs and the WHO

Key Recommendations from the Meeting

Member states are encouraged to:

1. Recognise myopia as an emerging problem in urban areas.
2. Improve quantity and quality of national surveys/data collection on refractive errors.
3. Train more refractionists/community optometrists/teachers in rural/underserved communities to provide services.
4. Refine curricula in school health programme to include extended outdoor time.
5. Effect policy changes around integration of eye health within school health programme including training of teachers for vision checks.
6. Carry out studies to support the assertion that increased outdoor activities will not compromise academic performance.
7. Address myopia as public health issue, with high myopia given even higher priority.
8. Push for development of treatments approved by international experts.
9. Review presenting visual impairment data, and not just corrected vision, to better illustrate this disability-causing problem.

NGOs are encouraged to:

1. Help countries develop and implement sustainable eye care models.
2. Take a proactive approach in educating about the health implications of high myopia.
3. Help countries that have vast regions and limited resources to access rural children.
4. Provide advocacy in a manner sympathetic to the language around myopia within-country to maximise communication and education.
5. Convene meetings to assist in advocacy and continue reporting on world vision.

WHO is requested to:

1. Having listed spectacles as an assistive device, work with member states to advocate to governments the medical necessity and effectiveness of spectacles.
2. Provide member states a summary of current evidence in myopia onset, prevalence and progression that can be used to develop national strategies.
3. Help design guidelines and procedures for myopia prevention and treatments that member states can follow.
4. Work with NGOs to educate communities and teachers about the dangers of high myopia.
5. Encourage member countries to work with their country WHO office to have an active relationship.

NGOs, non-governmental organisations.

Summary of recommendations

The key recommendations and possible routes of action from each stakeholder in executing strategies for myopia control are detailed in box 1. In summary, governments are encouraged to recognise myopia as an emerging public health issue that requires

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resources to carry out screening, and capacity building to collect accurate data and carry out public education on myopia. Increased outdoor time was almost universally stated as a top priority, which is already being emphasised by some governments in the region. However, participation by schoolchildren in increased outdoors activity would require cooperation and coordination between the education and health ministries within each country, and there is no consensus as to how much increase in outdoor time is feasible given the various constraints. Learning from the case studies that demonstrated successful attempts at holistic programme that encourage overall well-being in children might be useful. The WHO and non-governmental organisations play an important role in these strategies to ensure that public education and programmes are sustainable. WHO has added spectacles, a safe and effective way of correcting myopia, to the Priority Assistive Products List to promote spectacle accessibility within health systems.

CONCLUSIONS

Myopia is recognised as an important public health concern that will require concerted cooperation between different sectors of society and government. Accurate assessment of the burden of disease in each country, including rural or urban regions within the countries, will require standard assessment protocols including cycloplegic refraction and the increased training of healthcare professionals working in tandem with teachers and school nurses. Investments in access to primary eye care and infrastructure, including the provision of spectacles, is important for reducing uncorrected myopia—but requires further assessment by governments in terms of economic burden and implementation. In the meantime, coordination between ministries of health and education is encouraged to develop a holistic approach to towards myopia control by encouraging outdoors time which might also address other childhood related public health issues such as childhood obesity and mental health. Increased efforts on public education of both parents and teachers are recommended—to improve understanding of myopia, its consequences and ways to reduce myopia progression. One common challenge is convincing parents that increased outdoors time can be achieved without a loss of academic excellence, and teachers need to be supported in encouraging outdoor learning and play. Pharmacological and lens-related interventions for control of myopia progression should be considered where there are adequate facilities and trained professionals to initiate and monitor treatment. Furthermore, high myopia and pathological myopia need to be recognised as important causes of visual impairment, with more efforts required in developing myopia treatments and engaging more eye care practitioners to detect early complications, ensuring accurate and timely referrals for treatment.

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