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Good vision in older people has a significantly positive impact on their physical and mental health and their functional ability. NICARAGUA

Taking aim at refractive error

Refractive errors remain the leading cause of visual impairment globally. What is needed to ensure access to spectacle correction for everyone?

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Globally, uncorrected refractive errors are the main cause of visual impairment.[1] This translates to millions of people being negatively impacted in their lives due to lack of access to services and spectacles, resulting in lost education and employment opportunities, lower productivity, and impaired quality of life.

There is an urgent need for community-based strategies to tackle the rising prevalence of refractive errors and ensure equitable access to eye care services for all individuals, regardless of age, gender, socioeconomic status, or geographical location. By the year 2050, it is estimated that half the global population will be affected by myopia; this, as well as the emergence of myopic macular degeneration as an increasing cause of vision impairment, will require a significant focus on preventative and treatment strategies. In addition, with the global population growing and people living longer, there will be a significant increase in the number of people who need near vision spectacles for presbyopia.

The *Community Eye Health Journal* has produced this issue on refractive errors to further build on the knowledge of the eye care community, to address the pressing needs of the estimated 1 billion people worldwide who have vision impairment because they do not have access to a pair of spectacles. Rapid action is needed, which is why – in 2021 – the World Health Organisation member states endorsed a global target to increase effective refractive error coverage (eREC) by 40 percentage points.

In addition to articles about global magnitude of refractive error and the WHO SPECS 2030 initiative to help countries develop a solution and meet the 40 percentage point target, readers can also find specific guidance on managing various refractive conditions, including hyperopia, myopia, and presbyopia. Each condition presents unique challenges and requires tailored interventions to optimise visual outcomes and enhance quality of life for those affected.

About this issue

Globally, uncorrected refractive errors are the main cause of visual impairment. In this issue, we look at the World Health Organization's SPECS programme and the global data on refractive error. We also provide specific guidance on managing various refractive conditions, including hyperopia, myopia, and presbyopia, and cover practical skills essential for delivering comprehensive refractive error care in the community.

Contents

Through evidence-based recommendations and practical insights, these articles aim to equip eye health practitioners, managers, and policy makers with the knowledge and skills needed to support the management of refractive errors in their respective settings. This issue also provides valuable guidance on practical skills essential for delivering comprehensive refractive error care in the community. From guidance on performing cycloplegic refraction in school children to ensuring the correct prescription and fitting of spectacles, these skills are indispensable for promoting and supporting quality eye health outcomes.

School eye health

School health programmes are a vital opportunity to deliver eye health promotion, screening, examination, provision of glasses, and other services. To support the implementation of vision screening for children, the WHO released the Vision and eye screening implementation handbook (**bit.ly/WHOscreen**). For specific guidance on the implementation of a school eye health programme, the IAPB is revising and updating its current guidelines. These new guidelines will be launched at the IAPB 2030 Insight Live event in June 2024; the current guidelines are available at **bit.ly/IAPBschool**

A vision for the future

We need to work together to ensure that no individual is left behind in their journey towards optimal vision and well-being. By advocating for policies that promote equitable access to eye care services, investing in training and capacity building initiatives, and fostering partnerships with local stakeholders, we can create sustainable solutions that address the systemic barriers to accessible and quality refractive error services and improve eye health outcomes. Through collaboration, innovation, and a shared commitment to excellence and integration, we can build more robust systems and healthier, more resilient communities for the future.

Reference

1 GBD 2019 Blindness and Vision Impairment Collaborators; Vision Loss Expert Group of the Global Burden of Disease Study. Causes of blindness and vision impairment in 2020 and trends over 30 years, and prevalence of avoidable blindness in relation to VISION 2020: the Right to Sight: an analysis for the Global Burden of Disease Study. Lancet Glob Health. 2021;9(2):e144-e160.

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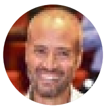
Global uncorrected refractive error and presbyopia: the size of the problem



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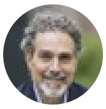

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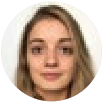

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Millions are struggling to learn, be healthy, and earn a living because they don't have spectacles.

A child is screened for refractive error in her school. ZIMBABWE

Uncorrected refractive error is often ignored in the realm of global health priorities, yet its substantial impact on the economic and personal wellbeing of individuals and societies worldwide is undeniable. Myopia (shortsightedness), hyperopia (farsightedness), and astigmatism, grouped together under the term 'refractive error', cause blurred distance and/or near vision, and presbyopia (age-related loss of accommodation) causes blurred near vision. Although presbyopia has a different mechanism to the other refractive errors, all these conditions can be corrected using spectacles or contact lenses. For the purposes of this article, therefore, we will use the term refractive error to refer to refractive error and presbyopia.

Unless refractive errors are corrected (using spectacles, contact lenses, or otherwise), the children and adults affected will experience difficulties in tasks that are crucial for daily living, education, and employment.

In this article, we summarise the estimated prevalence, the populations affected, and the implications if refractive error and optical services are not extended to everyone who needs them. We aim to equip policy makers and refractive error care providers alike to advocate for the resources required to tackle this global issue.

How big is the problem?

The estimates of global magnitude vary widely, due to relatively limited primary data and the different modelling assumptions made (see panel).

- **Blindness due to uncorrected refractive error** (defined as distance visual acuity worse than 3/60): the current estimate is 3.7 million[1,2]
- **Moderate or severe distance vision impairment due to refractive error** (defined as distance visual acuity worse than 6/18 but equal to or better than 3/60): estimates range from 123.7 million[3] to 157 million[1,2]
- **Near vision impairment due to presbyopia** (defined as near visual acuity worse than N6 at 40 cm): estimates range from 510 million[1,2] to 826 million.[3,4]

In total, up to 1 billion people worldwide, predominantly in Africa and Asia, are blind or have vision impairment because they do not have the spectacles they need.[1,2,3,4]

The prevalence and distribution of near and distance vision impairment due to uncorrected refractive error is expected to change significantly in coming decades, due in part to the rise of myopia, most rapidly in East Asia, and to a rise in presbyopia, due to population ageing.

Children and learning

Children are particularly vulnerable to the consequences of uncorrected refractive error. Children who do not receive adequate correction for their refractive error

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are at risk of lifelong visual impairment due to amblyopia. This not only affects the individual, but also stunts the development of entire communities and nations. In addition, uncorrected myopia and hyperopia can hinder academic progress, leading to lower educational attainment and future career opportunities. A myopic child who can't see the chalkboard may be misdiagnosed with learning disabilities.

Productivity and economic impact

Whereas cataract, the other leading cause of avoidable visual impairment, affects mostly older, non-working people, the impact of refractive error extends throughout the working-age population. Correcting refractive error increases productivity (by up to 32%[5]) and reduces absenteeism and job losses. This results in substantial economic gains for individuals and nations. In low- and middle-income countries, where access to vision care is limited, the economic consequences of not treating individuals is especially severe. Uncorrected myopia leads to an estimated global productivity loss of US $244 billion[6] while presbyopia may be responsible for a loss of between US $25 billion[7] and US $54 billion.[8]

Healthy ageing

Vision impairment has been associated with worse outcomes among older adults, including cognitive decline and dementia,[9] depression,[10] and increased risk of falls[11] and fracture,[12] all of which increase morbidity and mortality. Refractive services therefore have the potential to not only improve vision and quality of life, but also to save lives.

Eye health equity

Access to eye care is often inequitable and vision impairment due to refractive error can make this worse, with rural and marginalised communities suffering the most. This is true both on a global scale and within communities. Globally, South Asia, South East Asia, and sub-Saharan Africa have the highest prevalence of uncorrected refractive error (standardised for age).[2] Within communities, prevalence is higher, and willingness-to-pay (a measurement of how much a person can afford to spend) for spectacles is lower, among those with lower incomes.[13,14] Addressing refractive error is not just a matter of vision; it is a matter of social justice. It is about ensuring that everyone has the same opportunities for education, employment, and a high quality of life. Neglecting refractive error can worsen inequalities and social exclusion.

The role of refractive error care providers

Every eye care provider plays a crucial role in addressing this issue, whether on a local, regional, or global scale. Refractive service providers, usually led by optometrists, are the bridge between policy and practice: global health goals can only have a tangible impact if eye care workers are there to implement them.

Including eye care in general health care, and making spectacles for presbyopia available in the community (e.g., at pharmacies) is crucial given the scale of the problem; this is in line with WHO recommendations for the provision of presbyopia correction at the community level.[15] Technology provides an opportunity to ease this transition by making it possible to train community and primary health care workers from a distance, provide decision support algorithms, and the potential for remote supervision or telemedicine input when needed. Tele-refraction is a growing field, although there is not yet enough evidence supporting its use.[16]

Advocating for resources

Policy makers must prioritise uncorrected refractive error as a part of their broader health and development agenda. Investing in refractive error and optical services not only improves the lives of individuals, but also promotes economic development. Access to affordable spectacles and regular eye examinations should be integrated into national health systems.

Spectacles for near vision improve productivity. GHANA

Promoting education and awareness

Refractive error care providers can help raise awareness about the importance of regular eye examinations and the availability of affordable corrective measures. They can also advocate for comprehensive school vision screening programmes to identify and address refractive error in children early, and they can offer workplace assessments for employees as a way to increase productivity and safety. Refractive error correction is also key to road safety: visual impairment has been found to be associated with a 46% greater risk of road traffic collision.[17]

WHO SPECS 2030

In 2021, WHO member states endorsed a global target to increase effective refractive error coverage (eREC) by 40 percentage points. The World Health Organization has recently launched a new SPECS 2030 initiative, aiming to provide quality, affordable and people-centred refractive error services to everyone who needs them.

Conclusion

Near and distance vision impairment, due to uncorrected refractive error and presbyopia, is a global health issue with profound implications for individuals, communities, and nations. Stakeholders and health workers at all levels have a role to play in tackling this large, but solvable, problem. As policy makers and health service managers, the responsibility lies with you to allocate resources and prioritise refractive services in national health agendas. As refractive error care providers, the work you do restores not only your patients' eyesight, but also their education, income, and safety.

References

1 Burton MJ, Ramke J, Marques AP, Bourne RRA, Congdon N, Jones I, et al. The Lancet Global Health Commission on Global Eye Health: vision beyond 2020. Lancet Glob Health. 2021 Apr;9(4):e489-e551.

2 GBD 2019 Blindness and Vision Impairment Collaborators; Vision Loss Expert Group of the Global Burden of Disease Study. Trends in prevalence of blindness and distance and near vision impairment over 30 years: an analysis for the Global Burden of Disease Study. Lancet Glob Health. 2021;9(2):e130-e143.

3 World Health Organization. World Report on Vision. Geneva: WHO, 2019. **https://bit.ly/world-report-on-vision**

4 Fricke TR, Tahhan N, Resnikoff S, Papas E, Burnett A, Ho SM, Naduvilath T, Naidoo KS. Global Prevalence of Presbyopia and Vision Impairment from Uncorrected Presbyopia: Systematic Review, Meta-analysis, and Modelling. Ophthalmol. 2018;125(10):1492-9.

5 Reddy PA, Congdon N, MacKenzie G, Gogate P, Wen Q, Jan C, et al. Effect of providing near glasses on productivity among rural Indian tea workers with presbyopia (PROSPER): a randomised trial. Lancet Glob Health. 2018;6(9):e1019-27.

6 Naidoo KS, Fricke TR, Frick KD, Jong M, Naduvilath TJ, Resnikoff S, Sankaridurg P. Potential Lost Productivity Resulting from the Global Burden of Myopia: Systematic Review, Meta-analysis, and Modeling. Ophthalmol. 2019;126(3):338-46.

7 Frick KD, Joy SM, Wilson DA, Naidoo KS, Holden BA. The Global Burden of Potential Productivity Loss from Uncorrected Presbyopia. Ophthalmol. 2015;122(8):1706-10.
8 Ma Q, Chen M, Li D, Zhou R, Du Y, Yin S, et al. Potential productivity loss from uncorrected and under-corrected presbyopia in low- and middle-income countries: A life table modeling study. Front Public Health. 2022;10:983423.
9 Nagarajan N, Assi L, Varadaraj V, Motaghi M, Sun Y, Couser E, et al. Vision impairment and cognitive decline among older adults: a systematic review. BMJ Open. 2022;12(1):e047929.
10 Maier A, Riedel-Heller SG, Pabst A, Luppa M. Risk factors and protective factors of depression in older people 65+. A systematic review. PLoS One. 2021;16(5):e0251326.
11 Ehrlich JR, Hassan SE, Stagg BC. Prevalence of Falls and Fall-Related Outcomes in Older Adults with Self-Reported Vision Impairment. J Am Geriatr Soc. 2019;67(2):239-45.
12 Hamedani AG, VanderBeek BL, Willis AW. Blindness and Visual Impairment in the Medicare Population: Disparities and Association with Hip Fracture and Neuropsychiatric Outcomes. Ophthalmic Epidemiol. 2019;26(4):279-85.
13 Ramke J, Palagyi A, du Toit R, Brian G. Using assessment of willingness to pay to improve a Cambodian spectacle service. Br J Ophthalmol. 2008;92(2):170-4.
14 Ebri AE, O'Neill C, Azubuike K, Congdon N, Graham C, Lohfeld L, Chan VF. Caretakers' stated willingness to pay for children's spectacles in cross river state, Nigeria and its implication for a cross-subsidisation scheme: a cross-sectional study. BMC Public Health. 2023;23(1):1075.
15 World Health Organization. Package of Eye Care Interventions. Geneva: WHO. 2022 May 20. ISBN: 978-92-4-004895-9.
16 Blais N, Tousignant B, Hanssens JM. Tele-refraction in tele-eye care settings. Clin Exp Optom. 2022;105(6):573-81.
17 Piyasena P, Olvera-Herrera VO, Chan VF, Clarke M, Wright DM, MacKenzie G, et al. Vision impairment and traffic safety outcomes in low-income and middle-income countries: a systematic review and meta-analysis. Lancet Glob Health. 2021;9(10):e1411-22.
18 Holden et al (2016): Holden BA, Fricke TR, Wilson DA, Jong M, Naidoo KS, Sankaridurg P. Global Prevalence of Myopia and High Myopia and Temporal Trends from 2000 through 2050. Ophthalmol. 2016;123(5):1036-42.
19 Eliminating Poor Vision in a Generation Report: Essilor. Eliminating Poor Vision in a Generation: What will it take to eliminate uncorrected refractive errors by 2050? France: EssilorLuxottica. 2020. **bit.ly/visgen**

Recent global estimates of refractive error and presbyopia

These tables summarise some of the most widely accepted estimates of the magnitude of refractive error in recent years, and the studies on which these are based. Note that the Eliminating Poor Vision in a Generation Report uses a different threshold (visual acuity < 6/9), which has contributed to the large difference in reported magnitude. However, there remains a shortage of primary data on which to base estimates. Ongoing data collection via eye care programmes and surveys, such as Rapid Assessment of Avoidable Blindness (RAAB) surveys, should improve the accuracy of future estimates.

Table 1 Global estimates of the number of people with distance vision impairment or blindness due to refractive error (uncorrected, corrected, and total).

	Holden et al (2016)[18]	**Eliminating Poor Vision in a Generation Report[19]**	**World Report on Vision[3]**	**Vision Loss Expert Group[2] and Bourne et al (2020), Lancet Commission on Global Eye Health[1]**
Definitions	*≤ -0.5 diopter*	*Visual acuity (VA) < 6/9*	*Moderate to severe visual impairment (MSVI) 3/60 < VA < 6/18*	*MSVI or blindness (VA < 6/18)*
Uncorrected refractive error	-	2.7 billion[16,20]	123.7 million	161 million
Corrected refractive error	-	2.0 billion[16,20]	-	-
Total refractive error	2.6 billion (myopia only, for 2020)	4.7 billion[16,20]	-	-

Table 2 Global estimates of near vision impairment due to presbyopia.

	Fricke et al (2018)[4]	**Eliminating Poor Vision in a Generation Report[19]**	**World Report on Vision[3]**	**Vision Loss Expert Group and Bourne et al (2020),[2] Lancet Commission on Global Eye Health[1]**
Uncorrected presbyopia	826 million (for 2015)	-	826 million[4]	510 million (for 2020) 866 million (predicted for 2050)
Corrected presbyopia	1 billion	-	1 billion[4]	-
Total presbyopia	1.8 billion (2015)	1.4 billion[19] (with no other refractive error)	1.8 billion[4]	-

WHO SPECS 2030 – a global initiative to strengthen refractive error care

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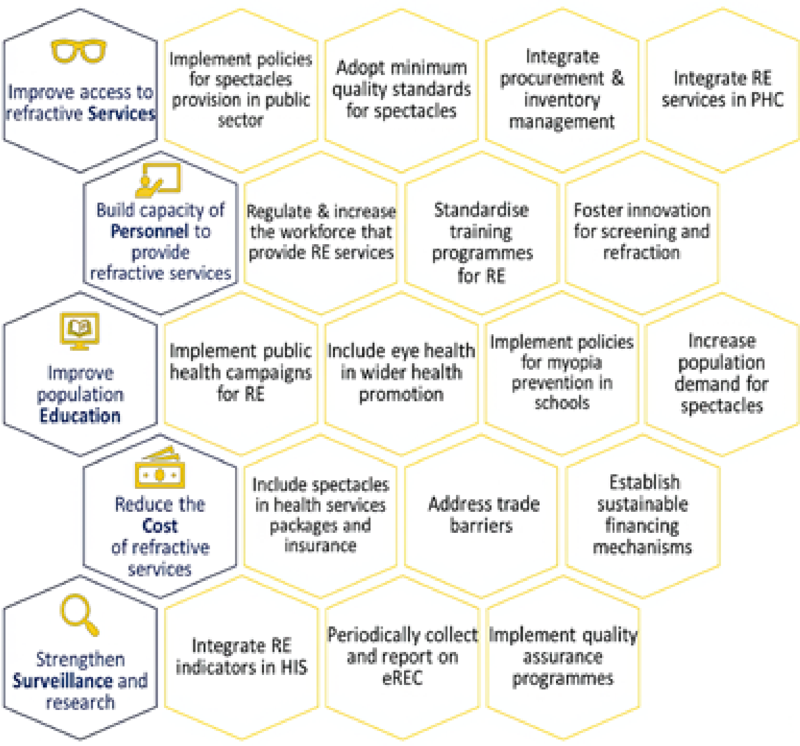
Coordinated global action is needed to improve access to refractive error services for everyone who needs it.

Spectacles improve access to education. KENYA

Globally, it is estimated that only around one-third of people with vision impairment due to refractive error have access to a pair of spectacles that can effectively address their refractive error and allow them to see well.[1] In recognition of the fact that uncorrected refractive error is the leading cause of near and distance vision impairment worldwide, and that spectacles are a very cost-effective intervention, a new global target for refractive error was endorsed at the World Health Assembly in 2021. Specifically, the global target is to increase the percentage of people with access to appropriate spectacles (known as effective coverage of refractive error, or eREC), by 40 percentage points by 2030.[2] This means that, if the global coverage was 30% in 2020, the aim would be to achieve 70% coverage in 2030.

Figure 1 The five strategic pillars of the WHO SPECS 2030 Initiative (in blue) and the country-level desired outcomes (in yellow).



RE = refractive error; eREC = effective refractive error coverage; HIS = health information systems

What are the key challenges to achieving the global 2030 target for refractive error?

There are many challenges to achieving the 2030 global target for refractive error. First, uncorrected refractive error tends to be much greater in populations that already have inadequate access to health care.[3] Second, refractive error and optical services are commonly only available in the private sector, and therefore costs pose a major barrier.[4] Other challenges include the insufficient availability of qualified personnel to carry out refraction and dispense spectacles, limited government oversight and clinical regulation, scarce services outside of urban areas, and low awareness and acceptance of spectacles among members of the public.

What is the WHO SPECS 2030 Initiative?

A comprehensive approach is needed to address these many long-standing challenges to increasing the coverage of refractive error services and – in particular – to strengthen provision in the government sector. The WHO SPECS 2030 Initiative calls for coordinated action amongst all stakeholders (public, private, non-profit, and philanthropy) across the following five pillars, in line with the SPECS acronym (Figure 1, in blue):

- **S:** Improve access to refractive **Services**
- **P:** Build capacity of **Personnel** to provide refractive services
- **E:** Improve population **Education**
- **C:** Reduce the **Cost** of refractive error services
- **S:** Strengthen **Surveillance** and research.

For each pillar, a set of country-level 'desired outcomes' have been defined by WHO, with input from the eye care sector,[5] that would facilitate a sustainable increase in refractive error coverage (Figure 1, in yellow).

The WHO SPECS 2030 Initiative aims to support the achievement of this target in four key ways.

1. Developing technical guidance and tools
This area of work will include, but is not limited to, the development of the following:

- Guidance on legislative issues that impact on increasing spectacle coverage, for example, integration of refractive error services into primary health care
- Models for competency-based teams for refractive error services
- A costing tool to support country planning
- Tools to strengthen monitoring and surveillance.

2. Bringing together the key providers and supporters of eye care to collectively promote and advocate to governments
WHO has set up the WHO Global SPECS Network (**www.who.int/initiatives/specs-2030/global-specs-network**) to bring together intergovernmental organisations, non-governmental organisations, academic institutions, the private sector, and philanthropic foundations.

"Organisations and institutions can apply to become members of the Global SPECS Network."

3. Motivating the private sector to make long-term contributions
WHO will convene a series of dialogues – the SPECS Private Sector Dialogues – with the optical, pharmaceutical, and technology industries, private sector service providers, and insurance companies. The dialogues will focus on how these groups can contribute to scaling up refractive error coverage, specifically targeting low- and intermediate-resource settings, in a way that will improve access and reduce the cost of refractive error services, especially in underserved populations.

4. Engaging with regions and countries
This may include WHO-led policy dialogues with governments to develop or strengthen refractive error services that are part of health systems, country-level workshops and training for health planners and health care providers, or capacity building and awareness raising within WHO regional and country offices.

School eye screening programmes cannot function without the support of adequate refractive error services. LIBERIA

Refractive error services should be available to all, regardless of the type of health condition or impairment an individual may have. NIGERIA

How to contribute to the WHO SPECS 2030 Initiative

Individuals who are involved in the provision and/or coordination of eye care are encouraged to advocate for the need to strengthen the provision of refractive services at all levels of the health system. To support this, a series of specific technical resources are available on the WHO SPECS 2030 website (**www.who.int/initiatives/specs-2030**). Additional resources will be added throughout 2024 and 2025.

Organisations and institutions can apply to become members of the Global SPECS Network. Further information regarding the eligibility criteria and how to apply can be found on the Global SPECS Network webpage (**www.who.int/initiatives/specs-2030/global-specs-network**).

Finally, **private sector representatives** are encouraged to join the SPECS Private Sector Dialogues already mentioned, for which registration will open in mid-2024.

For more information, please contact the WHO Vision and Eye Care Programme (**vision@who.int**).

References

1 World Health Organization. Report of the 2030 targets on effective coverage of eye care [Internet]. Geneva: World Health Organization; 2022 (**https://apps.who.int/iris/handle/10665/363158**, accessed 20 December 2023).

2 Resolution WHA74(12). Integrated people-centred eye care, including preventable vision impairment and blindness. In: Seventy-fourth World Health Assembly, Geneva, 24–31 May 2021. Geneva: World Health Organization; 2021

3 WHO. World report on vision. Geneva: World Health Organization; 2019.

4 WHO. Package of eye care interventions. Geneva: World Health Organization; 2022.

5 WHO. Global Refractive Error Expert Consultation, WHO Headquarters, Geneva, Switzerland, Meeting Report; 2023.

What can we do about myopia? An evidence-informed approach

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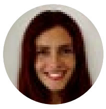

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Prevention is vital to reduce the number of people with myopia, and management strategies are effective in reducing the progression of myopia and decreasing the risk of sight-threatening complications.

By 2050, it is estimated that half the world's population will have myopia. NEPAL

Myopia – short-sightedness – is a significant problem around the world. Currently, one in three people on the planet have myopia; by the year 2050, it is estimated that one in every two individuals will be affected.

Myopia typically starts to develop in childhood and tends to progress to higher levels until adulthood. The earlier myopia starts, the more likely a child will end up with high levels of myopia, which puts them at greater risk of complications, such as myopic maculopathy, which may result in loss of vision. Whilst any level of myopia may cause complications, the risk increases with increasing levels of myopia.[1]

"Myopia typically starts to develop in childhood and tends to progress to higher levels until adulthood."

Who is at risk?

Those who are most at risk of developing myopia are children who spend less time outdoors and more time indoors on near tasks, children who have higher levels of education, and children who have parents with myopia. People of East Asian ethnicity are also at higher risk.

Impact of myopia

If left uncorrected, poor vision in childhood can hinder school performance and wellbeing. Quality of life is affected in people with higher levels of myopia and people with myopia-related complications. Given the progressive nature of the condition, myopia has a financial impact on the families of affected individuals and on society, due to the health expenditure related to the costs of managing the condition as well as costs related to eye examinations, corrective devices, and lost productivity.

The rising prevalence of myopia is expected to strain eye care, health, and education systems. Vision loss due to myopia may result in productivity loss and the resulting economic burden may be significant for those countries with a higher prevalence of myopia.

Prevention

Due to the progressive nature of myopia, preventing or delaying the onset is currently the most effective way to tackle the burden of myopia .

It is well established that increasing time outdoors can greatly reduce the risk of developing myopia. Therefore, the current recommendation is that **children should spend at least 2 hours outside each day** to prevent or delay the onset of myopia.[2]

Public messages about the prevention of myopia is the responsibility of all stakeholders, including researchers, clinicians, health bodies, and governmental authorities. To achieve widespread public awareness, various channels of communication such as engaging with parents and carers, involvement in community groups and schools, as well as print and social media campaigns should be considered.

Treatment

Once myopia has been diagnosed, it is possible to offer treatment that not only corrects visual symptoms, but also slows progression. (Note: a comprehensive eye examination for children should include cycloplegia if possible; see the article on cycloplegia in this issue).

There are a growing number of management options that have been shown to be effective at slowing the progression of the condition, including:

- Specially designed spectacle lenses and contact lenses
- Orthokeratology

- Eye drops containing low concentrations of atropine
- Light-based therapies
- Combination treatments, involving one or more of these categories.

Research into the efficacy of different myopia control interventions is ongoing,[3] which makes it challenging to stay up to date with the latest scientific evidence.

Several organisations and professional bodies have developed resources to help clinicians make evidence-informed decisions about myopia control for their patients.

The IMI's reviews of evidence, published as open access white papers (**tinyurl.com/IMI-whitepapers)** have been summarised in a 2-page infographic, available at **myopiainstitute.org/myopia-infographics/**

The World Council of Optometry (WCO) has developed a 'Standards of Care' guideline (**bit.ly/WCOstandard**) and a practical guide to managing children with myopia (**bit.ly/4agfYxu**).

For clinical guidelines, it may be useful to refer to optometry and ophthalmology associations. They have an obligation to stay up to date and their purpose is to help clinicians – look to your local associations for relevant local guidelines. They do vary, and some suggest referral pathways. In addition to clinical efficacy, there are several other factors that will guide the choice, implementation and success of myopia management options, including:

- The availability of different interventions in your country, and whether they have been approved by professional and regulatory bodies.
- The cost of interventions, and patients' ability to pay for them.
- How acceptable the interventions are to patients. This could depend on comfort and visual performance, for example.
- How familiar practitioners are with the different myopia control strategies, and how confident they feel about implementing them.

Are these treatments safe and comfortable?
Overall, adverse events associated with various myopia control strategies have been reported to be minimal, although more data is needed to establish the safety of light therapy.

Using atropine at concentrations higher than 0.01% may cause side effects such as increased pupil size, accommodation paralysis, photophobia, glare, and blurred near vision, but these effects are reversible when treatment is stopped.

Due to the optical design features needed for spectacles and contact lenses used in myopia control, visual disturbances have been reported, which vary with lens design. These include haze and ghosting (with multifocal contact lenses) and reduced visual performance in the periphery (with certain spectacle lens designs). The latter is usually limited to one line reduction in the peripheral treatment areas of the spectacle lenses.

Although complications with contact lenses and orthokeratology are rare, they include microbial keratitis and infiltrates, with daily disposable wear minimising such risks.

The safety of low-level red-light therapy requires further study, although known side effects involve temporary after-flash images and rare cases of retinal damage that resolved without lasting effects.

A note on rebound
With myopia control treatments involving higher doses of atropine and red-light therapy, an accelerated increase in myopia has been reported once these treatments are stopped. This effect, known as rebound, tends to be more pronounced in initial months after treatment is stopped. To mitigate rebound, a tapered approach is recommended, although the efficiency of tapering methods needs further evaluation.

With optical strategies, studies with orthokeratology indicate some rebound when switching from orthokeratology to single vision lenses, but no rebound was reported with contact lenses or spectacles.

"Prevention of myopia through lifestyle changes is still the most effective way to address this growing problem."

Conclusion

In conclusion, prevention of myopia through lifestyle changes is still the most effective way to address this growing problem. Myopia management approaches have been growing and have proven to be effective in reducing the risk of myopia progression. Data and modelling indicate that various approaches have the potential to positively influence outcomes for individuals as well as benefit society at large. Ongoing research and advancement will continue to shape the future landscape for myopia prevention and management.

How is the effectiveness of myopia control strategies measured?

The effectiveness of interventions to slow myopia progression can be measured by observing the change in refractive error, measured in dioptres, or the change in axial length, measured in mm.

Effectiveness is often reported as 'relative efficacy'. In these studies, the progression of refractive error (in dioptres) in the group using the myopia intervention is compared with the progression in a control group of children using standard single-vision spectacles or contact lenses. Because control groups can differ between studies, it is important to be cautious when using this measurement to compare different treatment options.

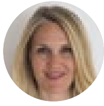
Another approach to measuring the effectiveness of interventions is to compare myopia control strategies to the natural eye growth observed in non-myopic (emmetropic) eyes. Axial length measurements are also considered more accurate than refractive error measurements for assessing progression.

References

1 Sankaridurg P, Tahhan N, Kandel H, et al. IMI Impact of Myopia. Invest Ophthalmol Vis Sci 2021;62(5):2. doi: 10.1167/iovs.62.5.2

2 Morgan IG, Wu PC, Ostrin LA, et al. IMI Risk Factors for Myopia. Invest Ophthalmol Vis Sci 2021;62(5):3. doi: 10.1167/iovs.62.5.3

3 Sankaridurg P, Berntsen DA, Bullimore MA, et al. IMI - 2023 Digest. Invest Ophthalmol Vis Sci 2023;In Press



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Presbyopia: addressing an urgent global need

Addressing presbyopia – the most common global cause of visual impairment – can boost income and productivity while providing a gateway to wider eye health care.

A woman is screened for presbyopia using a simple, printed one-page eye chart. TANZANIA

Presbyopia is the age-related deterioration of a person's near vision, making it difficult to focus clearly on reading materials or other nearby objects. It typically begins around age 40 due to a loss of elasticity of the lens of the eye. Near vision continues to deteriorate until about the age of 60 to 65, when the condition stabilises.

Presbyopia is the most common cause of vision impairment globally, impacting 1.8 billion people.[1] Almost every person will experience presbyopia if they live into their 50s and beyond.

Presbyopia is addressed with the use of near-vision spectacles. These are commonly called 'ready-made' reading glasses, reading spectacles, or readers, although they have many uses in addition to reading. These spectacles are critical for people with presbyopia who rely on their ability to see close-up to work, read, learn, and perform day-to-day tasks and activities. People who also have problems with distance vision or astigmatism may need combined distance and near vision correction in the form of bifocal or progressive lenses, for example.

The impact of unaddressed presbyopia

According to the World Health Organization's World Report on Vision[1] (based on research by Fricke et al.[2]), more than 1 billion people have a vision impairment that could have been prevented or is yet to be addressed. Of these, more than 800 million people are estimated to be visually impaired due to uncorrected presbyopia and need only reading spectacles to be able to see clearly.[1]

> "Almost every person will experience presbyopia if they live into their 50s and beyond."

It is estimated that 90% of people with uncorrected presbyopia live in low and middle-income countries. Without proper reading spectacles, they are being driven deeper into poverty as their blurred vision inhibits their ability to work, causing them to lose their jobs and livelihoods. Addressing presbyopia therefore presents a significant opportunity to improve income, productivity, and quality of life for hundreds of millions of people worldwide. Because it can be corrected at low cost with vision screenings and ready-made reading spectacles, presbyopia can and should be addressed on a much larger scale.

For people with presbyopia, receiving ready-made reading spectacles leads to positive changes in livelihoods, worker productivity, income, health, opportunities for education and lifelong learning, and overall well-being. In a randomised controlled trial (RCT), tea pickers who received reading spectacles were up to 32% more productive in their jobs than their peers in the control group.[3] In another RCT, workers across a range of visually intensive jobs saw their incomes increase by nearly US $12 a month, an increase of 33.4%.[4] In comparison, providing reading spectacles at scale can cost as little as US $2 per person, including programme costs (based on RestoringVision's 2023 programmes, which reached 4 million people in 106 countries); making it a highly cost-effective intervention.

Many occupations require near vision, including tea and coffee pickers, textile workers, artisans, tailors, weavers, community health workers, midwives, mechanics, carpenters, plumbers, barbers, people who braid hair, and people who rely on their mobile phones for their livelihoods. In addition, in our work, many people have reported significant improvement in their quality of life when they are again able to read their holy scriptures and texts, communicate effectively through their mobile phones with family and friends, and engage in other activities that require near vision.

A global issue

There is a growing understanding that uncorrected presbyopia and other forms of refractive error are a critical public health issue. Accordingly, World Health Organization (WHO) member states set an ambitious target to increase effective refractive error coverage by 40 percentage points by 2030. To accelerate the achievement of this target, WHO developed the SPECS 2030 initiative,[5] which seeks to mobilise coordinated action across governments, civil society, and the private sector to increase spectacle coverage, especially in low and middle-income countries. The United Nations General Assembly also called for improving eye health and access to spectacles among its member states in a 2021 resolution, recognising the importance of eye health in achieving the Sustainable Development Goals.[6]

What can be done?

Two key actions are needed:

1 Integrating presbyopia screening and correction at the community and primary care level
2 Aligning policies to support and accelerate the provision of spectacles for presbyopia

1. Integrating presbyopia screening and correction at the community and primary care level
WHO recommends that presbyopia correction is provided at the community and primary eye care level.[7]

In our experience, vision screening programmes to address presbyopia can readily be embedded within government and nongovernmental programmes and systems across a range of sectors, including health, education, agriculture, pensions, and social protection. This integration is a promising way to address presbyopia at scale, which can have an immediate and sustained impact in the lives of people reached and accelerate achieving the SPECS 2030 goal of increasing effective refractive error coverage. Due to the cost-effectiveness of programmes addressing presbyopia, these programmes can be implemented at scale. Several near vision testing methodologies can be used, including WHOeyes (bit.ly/WHOeyes), a new free mobile app by WHO, or a printed near vision eye chart with text, numbers, or symbols (like tumbling Es).

If a person's primary complaint is difficulty seeing at near distances (close-up), and the vision test confirms this, they can be given a pair of good quality, low-cost, ready-made reading spectacles to correct their vision impairment. If the individual presents with other eye conditions or concerns, they can be referred for a full eye examination.

Access to reading spectacles can increase people's productivity and earnings. VIET NAM

Addressing presbyopia in this way can bring many people into the eye health care system for the first time. This provides a key opportunity to identify other critical eye conditions such as cataracts, glaucoma, or diabetic retinopathy, which are more prevalent in the age group of people typically affected by presbyopia.

Presbyopia programmes can also play an important role in building public awareness and understanding of wider eye health issues and risks. In our work, we have found that these programmes demonstrate the extent of visual impairment due to refractive error and the value of addressing this. In turn, this can lead to greater interest in the strengthening of comprehensive eye care programmes and greater allocation of resources for this purpose.

2. Aligning policies to accelerate the provision of spectacles for presbyopia
In many high-income countries, reading spectacles are sold 'over the counter' at low cost in shops and pharmacies, making them accessible and affordable to people who only need near vision correction. However, in many other parts of the world, including low and middle-income countries, reading spectacles are inaccessible and unaffordable for hundreds of millions of people, often due to policies that affect the cost of these spectacles, and how and where they can be provided.

There are two types of policies that can support addressing presbyopia on a larger scale.

1 **Policies on who can screen and dispense.** Many countries do not require reading spectacles to be dispensed only by trained eye health professionals. Instead, these spectacles can be provided by people with basic training in screening and dispensing or they can be made more widely available, so that individuals can select and purchase the pair that suits their visual needs.
2 **Policies on importing near vision spectacles.** Many countries allow the importation of reading spectacles duty-free or at a lower rate to ensure that these health products are accessible and affordable. This is an effective way to facilitate scaling up the response to presbyopia.

Unfortunately, a significant number of countries with very large populations of people with uncorrected presbyopia have not yet adopted these policies. It is recommended that these countries revise their policies in order to accelerate their achievement of the 40 percentage point increase in effective coverage for refractive error as outlined by WHO.[5]

What about the need for a comprehensive eye examination?

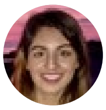
While there is consensus on the benefits of a comprehensive eye examination – every person should ideally have one every 1–3 years, depending on their age and health status – the number of optometrists and ophthalmologists in low- and/or middle-income countries is insufficient to meet the needs of the population. For example, fourteen low- and/or middle-income countries have fewer than one ophthalmologist per 1 million people, and another 31 countries have only 1–3 ophthalmologists per 1 million people. Ophthalmologists and optometrists also tend to be concentrated in urban areas.[8]

In these contexts, it is not feasible (or affordable) for everyone who needs a pair of reading spectacles to consult with an ophthalmologist or optometrist. Until the workforce can catch up with the need, it is vital for people to be screened and gain access to this essential product in a way that promotes overall eye health, as it can be the difference between someone sustaining their livelihood or not.

References

1 World report on vision. Geneva: World Health Organization; 2019. Available from: **https://bit.ly/world-report-on-vision**
2 Fricke TR, Tahhan N, Resnikoff S, Papas E, Burnett A, Ho SM, Naduvilath T, Naidoo KS. Global Prevalence of Presbyopia and Vision Impairment from Uncorrected Presbyopia: Systematic Review, Meta-analysis, and Modelling. Ophthalmol. 2018;125(10):1492–9.
3 Reddy PA, Congdon N, MacKenzie G, Gogate P, Wen Q, Jan C, Clarke M, Kassalow J, Gudwin E, O'Neill C, Jin L, Tang J, Bassett K, Cherwek DH, Ali R. Effect of providing near glasses on productivity among rural Indian tea workers with presbyopia (PROSPER): a randomised trial. Lancet Glob Health. 2018;6(9):e1019-e1027.
4 Sehrin F, Jin L, Naher K, Das NC, Chan VF, Li DF, et al. (2024) The effect on income of providing near vision correction to workers in Bangladesh: The THRIVE (Tradespeople and Hand-workers Rural Initiative for a Vision-enhanced Economy) randomized controlled trial. PLoS ONE 19(4): e0296115.
5 Keel S and Mueller A. WHO SPECS 2030 – A global initiative to strengthen refractive error care. Comm Eye Health J. 2024; Epub ahead of print. Available from: **https://bit.ly/CEHJSPECS**
6 United Nations General Assembly, document A/75/L.108
7 Package of eye care interventions. Geneva: World Health Organization; 2022.
8 Resnikoff S, Lansingh VC, Washburn L, Felch W, Gauthier TM, Taylor HR, Eckert K, Parke D, Wiedemann P. Estimated number of ophthalmologists worldwide (International Council of Ophthalmology update): will we meet the needs? Br J Ophthalmol. 2020;104(4):588-592.

Hyperopia: a practical introduction



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Hyperopia is a common eye condition in children that affects near vision. Detecting and treating it in time can reduce the risk of squint and amblyopia.

Figure 1 Measuring near visual acuity with a conventional LogMAR near vision chart using Lea symbols at 40 cm. ZIMBABWE

Hyperopia, also called farsightedness, is a common problem in children worldwide. The limited data available suggest that around 4.6% of children, on average, have clinically significant hyperopia (defined as a spherical equivalent of ≥+2.00 D), ranging from 2.2% in Southeast Asia to 14.3% in the Americas.[1]

Hyperopia affects the eye's ability to focus, especially at near distances. This happens when the eyeball is too short, or the cornea is not curved enough, causing the rays of light to focus behind the retina instead of on it. Babies are usually born moderately hyperopic, but this gradually decreases as their eyes grow and develop: from an average spherical equivalent of +2.00 D at age 3 months, to just over +1.00 D by the time they are 3 or 4 years old.[2,3]

Children with adequate focusing ability (accommodation) can often overcome uncorrected hyperopia, including clinically significant hyperopia (defined as ≥+2.00 D). When these children start attending school, however, the need to accommodate for longer periods of time can lead to eye strain, headaches, and blurred vision, which can affect their reading and other school-related tasks. Children who have higher levels of hyperopia that cannot be overcome using their accommodative ability experience poorer near vision and near depth perception, which also affects their academic performance.[4] Some children may even experience poorer distance vision due to hyperopia.

Figure 2a Children with hyperopia will not experience significant blurring of their distance vision when looking through a +2.50 D lens.

Figure 2b A child who does not have hyperopia will experience significant blurring of their vision when looking through a +2.50 D lens.

Unless their hyperopia is corrected by the age of 7 years, children with clinically significant uncorrected hyperopia (defined as ≥+2.00 D) are also at risk of developing strabismus and amblyopia, resulting in irreversible visual impairment in the affected eye.[5,6]

Screening for hyperopia

Because screening for hyperopia is challenging, children with clinically significant hyperopia are often not identified or treated. At present, the distance visual acuity (VA) test is the main method used in school-based programmes in low- and middle-income countries to identify children with reduced vision. This test is useful in detecting myopia, but not always hyperopia, as only some children with clinically significant hyperopia experience reduced distance vision.

Given the fact that the majority of a child's visual development is thought to happen by the age of 7 years, it is important to detect and treat clinically significant hyperopia as early as possible. However, in settings with limited resources, it is usually recommended to do this when children start school.

There is no globally accepted consensus on how to screen children for hyperopia. We recommend using either the **plus-lens test** or the **near visual acuity test** to screen for significant hyperopia, but only if there are enough resources and well-trained personnel to carry out the tests.

1. The plus lens test

The plus lens test involves putting a +2.50 D lens in front of the eye and measuring the difference (if any) in distance visual acuity.

Because children with hyperopia can see more clearly through a plus lens, especially at near distances, the addition of a plus lens should not affect their distance visual acuity very much (Figure 2a). Children who do not have hyperopia, however, will experience significant blurring of their vision when looking through the same lens (Figure 2b).

To distinguish between children with and without clinically significant hyperopia, the criteria for failing or passing the test are as follows:

Fail (child has hyperopia): The distance visual acuity while looking through +2.50 D lens worsens by **two lines or less** compared to the unaided distance visual acuity.

Pass (no hyperopia): The distance visual acuity while looking through the +2.50 D lens worsens by **more than two lines** compared to the unaided distance visual acuity.

How to perform the plus lens test

1. After completing the unaided distance visual acuity test, cover the left eye and place a +2.50 D lens over the child's right eye.
2. Direct the child's attention to the distance vision chart and check their visual acuity again, by asking them to identify the letters or symbols.
3. Decide whether the child has passed or failed, using the criteria above.
4. Repeat for the other eye.

2. The near visual acuity test

The near visual acuity test involves measuring the near distance vision. To distinguish between children with and without clinically significant hyperopia, the criteria for failing or passing the near visual acuity test are as follows:

Fail (child has hyperopia): If the child is unable to correctly identify 3 out of 5 letters or symbols on the 0.2 LogMAR (or 6/9.5 Snellen) line.

Pass (no hyperopia): If the child is able to correctly identify 3 out of 5 letters or symbols on the 0.2 LogMAR (or 6/9.5 Snellen) line.

The steps are as follows:

1. Use a near visual acuity chart, such as a Sloan letter or Lea symbol chart; the latter is helpful for children who are not comfortable with the alphabet.
2. Hold the near visual acuity chart at 40 cm from the face, at eye level (Figure 1). Ensure that the child is not leaning forward.
3. Cover the left eye with an occluder or patch and test the right eye.
4. Ask the child to identify the letters or symbols on each line, as directed.
5. Decide whether the child has passed or failed the test, using the criteria mentioned earlier.
6. Repeat for the other eye.

Prescribing for hyperopia

To determine the amount of hyperopia, it is advisable to conduct a cycloplegic refraction whenever possible, as it yields reliable measurements (see article on cycloplegic refraction in this issue).

When prescribing spectacles for hyperopic children, the aim is to decrease the demand for focusing (accommodative demand) and provide clear and comfortable vision with both eyes. Therefore, eye care providers should prescribe the maximum plus power that children can comfortably accept while still maintaining clear vision. Factors to consider include the child's age, the amount of hyperopia in each eye, and the presence of strabismus, among others. In most cases, children are better able to tolerate a lower plus prescription, except when there is an inward eye turn (esotropia). In such cases, the full cycloplegic correction is required to minimise or eliminate the squint.

"To determine the amount of hyperopia, it is advisable to conduct a cycloplegic refraction whenever possible."

It is also important to recognise that children with anisometropia (a difference in refractive error between the eyes) of +1.00 D or greater, or who have a similar level of hyperopia (isometropia) of +5.00 D or greater in both eyes, are at risk of hyperopic refractive amblyopia.[7,8] The American Academy of Ophthalmology has practical guidelines for these children, according to age and other factors (see Table 1).

Table 1 The American Academy of Ophthalmology's recommended prescribing guidelines for hyperopia. Available at **tinyurl.com/AAOhyperopia**

For children with isometropia (similar level of refractive error in both eyes)				
Refractive status	**Age < 1 year**	**Age 1 to < 2 years**	**Age 2 to < 3 years**	**Age 3 to < 4 years**
Hyperopic isometropia (without esotropia)	≥ + 5.00 D	≥ + 5.00 D	≥ + 4.50 D	≥ + 3.50 D
Hyperopic isometropia (with esotropia)	≥ + 1.50 D	≥ + 1.00 D	≥ + 1.00 D	≥ + 1.00 D

(Source: **AAO Prescribing guidelines for hyperopia**)

For children with anisometropia (an unequal level of refractive error between the eyes)				
Refractive status	**Age < 1 year**	**Age 1 to < 2 years**	**Age 2 to < 3 years**	**Age 3 to < 4 years**
Hyperopic anisometropia (without esotropia)	≥ + 2.50 D	≥ + 2.00 D	≥ + 1.50 D	≥ + 1.50 D

(Source: **AAO Prescribing guidelines for hyperopia**)

References

1 Hashemi H, Fotouhi A, Yekta A, Pakzad R, Ostadimoghaddam H, Khabazkhoob M. Global and regional estimates of prevalence of refractive errors: Systematic review and meta-analysis. Journal of Current Ophthalmology. 2018;30(1):3-22.

2 Mayer DL, Hansen RM, Moore BD, Kim S, Fulton AB. Cycloplegic Refractions in Healthy Children Aged 1 Through 48 Months. Archives of Ophthalmology. 2001;119(11):1625-8.

3 Mutti DO, Sinnott LT, Lynn Mitchell G, Jordan LA, Friedman NE, Frane SL, et al. Ocular Component Development during Infancy and Early Childhood. Optom Vis Sci. 2018;95(11):976-85.

4 Kulp MT, Ciner E, Maguire M, Moore B, Pentimonti J, Pistilli M, et al. Uncorrected Hyperopia and Preschool Early Literacy: Results of the Vision In Preschoolers - Hyperopia In Preschoolers (VIP-HIP) Study. Ophthalmology. 2016;123(4):681-9.

5 Pascual M, Huang J, Maguire MG, Kulp MT, Quinn GE, Ciner E, et al. Risk factors for amblyopia in the vision in preschoolers study. Ophthalmology. 2014;121(3):622-9.e1.

6 Cotter SA, Varma R, Tarczy-Hornoch K, McKean-Cowdin R, Lin J, Wen G, et al. Risk factors associated with childhood strabismus: the multi-ethnic pediatric eye disease and Baltimore pediatric eye disease studies. Ophthalmology. 2011;118(11):2251-61.

7 Dobson V, Miller JM, Clifford-Donaldson CE, Harvey EM. Associations between Anisometropia, Amblyopia, and Reduced Stereoacuity in a School-Aged Population with a High Prevalence of Astigmatism. Invest Ophthalmol Vis Sci. 2008; e49(10):4427-36.

8 Kulp MT, Ying GS, Huang J, Maguire M, Quinn G, Ciner EB, et al. Associations between hyperopia and other vision and refractive error characteristics. Optom Vis Sci. 2014;91(4):383-9.

Cycloplegic refraction in children

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Cycloplegic refraction makes it possible to accurately measure a child's refractive error and provide appropriate correction.

Children are eager to please and they may try too hard to give the 'correct' answers during refraction; this can result in an inaccurate spectacle prescription. PAKISTAN

The prevalence of uncorrected refractive errors in children is on the rise globally.[1] Uncorrected refractive errors can affect children's ability to develop good vision and also hamper their education and social activities. It is therefore important to measure a child's refractive errors accurately.

Accommodation is the ability of the eye to focus on objects at varying distances. This ability is greatest in children and declines with age – usually becoming noticeably reduced after the age of 40 with the development of presbyopia, when the eye loses the ability to focus on near objects.

Children's wonderful ability to accommodate can, however, affect the accuracy of refractive error assessment: children often try too hard to give the 'correct' answers, which leads them to subconsciously over-focus, resulting in an inaccurate spectacle prescription. Typically, myopia will be overcorrected, and hyperopia (long-sightedness) will be under-corrected; astigmatism could also be misdiagnosed. Children could therefore be prescribed unnecessary spectacles for myopia or astigmatism, or miss out on getting spectacles to correct hyperopia. Wearing incorrectly prescribed spectacles could lead to non-optimal vision, eye strain, headaches, nausea, strabismus (squint), and amblyopia (lazy eyes), and it could even hasten myopia progression.[2]

"Children's wonderful ability to accommodate can, however, affect the accuracy of refractive error assessment."

In order to achieve accurate results, accommodation can be controlled by using cycloplegic eye drops to temporarily paralyse the muscles used in accommodation, followed by retinoscopy (known as wet retinoscopy) or subjective refraction (wet refraction).

Commonly used eye drops for this purpose are cyclopentolate, tropicamide, and atropine.

Cyclopentolate 1% (0.5% for children aged less than 1 year) is accepted as the gold standard for cycloplegic refraction. It is fast and relatively short acting and is suitable for most patients.

Tropicamide 1% is fast acting and has a shorter duration but has a weaker cycloplegic effect, so it is better suited to older children. While tropicamide has been shown to yield similar refraction results to cyclopentolate, care needs to be taken in cases of high hyperopia, strabismus, or when there is inconsistency between examination results and clinical manifestations of vision problems.[3]

Both types of drops are safe, with cyclopentolate reporting some extremely rare side effects.[4] Systemic absorption can be minimised by occluding the puncta after instillation and wiping away any excess drops. Where cyclopentolate is not available, or in children with known sensitivity, central nervous system disorders, or Down syndrome, tropicamide is a viable alternative.[5]

Atropine 1% is commonly used in some settings, but caution is advised. Atropine is slow acting and has a longer duration with effects lasting several days; this can cause discomfort. In children with very darkly pigmented eyes, atropine is often recommended when cyclopentolate is not effective. Note that atropine can be poisonous when absorbed systemically: a 3 g tube of 1% atropine ointment can be fatal if ingested accidentally by a small child.[6]

When is cycloplegic refraction needed?

Ideally, all children with suspected refractive errors should undergo cycloplegic refraction at least once when they are identified, and subsequently when it is suspected that the child is accommodating during refraction. However, there are legislative limitations in many countries as to who can use pharmaceutical agents for eye examinations, with the use of diagnostic eye drops often restricted to medical doctors only.

Where the use of pharmaceutical agents is not allowed, alternative methods of controlling accommodation (such as fogging lenses for retinoscopy or refraction) may be considered, although these may be less effective.[7,8] In older children (aged 11–18 years), conducting retinoscopy without cycloplegia (dry retinoscopy) may provide satisfactory results. However, if any of the indications listed in the panel are present, and dry refraction does not yield reliable results, then cycloplegic refraction is indicated.

How to perform cycloplegic refraction in school-aged children

Children often do not like drops in their eyes, and cycloplegic drops can be particularly uncomfortable.

Although some eye care providers suggest instilling an anaesthetic eye drop before instilling the cycloplegic eye drop, in our experience instilling a single drop (just the cycloplegic agent) is less stressful for the child.

The following steps are designed to be reassuring for the child and to support their cooperation with the process of cycloplegic refraction.

1 Wash your hands and explain to the child and/or their caregiver what you are going to do. We recommend telling the child that the drops may make their eyes feel 'funny'; avoid using the word 'sting.'
2 Ask the child to sit on their parent or carer's lap; this is often the most comfortable place for the child.
3 Ask the child to look up. As shown in Figure 1, gently pull the lower eyelid down to create a 'sac' (the lower fornix). Instil **one** drop of cyclopentolate 1% (or tropicamide 1%, if cyclopentolate is not available) into the lower fornix.
4 Wipe away any excess drops and gently press a finger against the inner corner of the eye, next to the nose, to occlude the puncta for 1–2 minutes. This will minimise systemic absorption.
5 Repeat steps 3 and 4 in the other eye.
6 If, after 15 minutes of instilling cyclopentolate, the pupils do not appear to be dilating, **and** the child has darkly pigmented eyes, instil another drop and repeat punctal occlusion for 1–2 minutes.

Figure 1 Gently pull down the lower eyelid to create a 'sac'. UK

Other indications for cycloplegic refraction

Cycloplegic refraction can be helpful in the following circumstances. Refer to your professional association's guidelines for more detailed recommendations.

- Undiagnosed manifest esotropia
- An esotropia recognised by the parent or carer
- Unstable or uncompensated esophoria
- Significant risk factors for esotropia or amblyopia, such as family history or high refractive errors
- Good visual acuity is not achieved following a dry refraction
- Stereoscopic acuity is poor
- Latent hyperopia or pseudomyopia is suspected.

7 Wait 30–40 minutes (15–25 minutes for tropicamide 1%), then check that the pupils are dilated and do not constrict when light from a torch is shone onto them. If the pupils constrict, wait another 5 minutes and check reactivity to light again.
8 When the pupils are unreactive to light, perform retinoscopy or subjective refraction.
9 Advise parents that the child will have dilated pupils, blurry vision up close, and sensitivity to bright light for several hours afterwards.

For more practical tips on instilling eye drops in a young child, visit **tinyurl.com/CEHJ-eyedrops**.

A need for advocacy

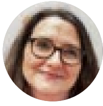
Atropine and tropicamide are widely approved for use in low- and middle-income settings. Cyclopentolate is less widely approved, but it is listed as an alternative to atropine and tropicamide in the WHO Model List of Essential Medicines 23rd List (2023).

To address the increasing demand for accurate refraction in children, we need to advocate for legislation that would allow qualified and appropriately trained eye health professionals, such as optometrists, to use the best cycloplegic agent (cyclopentolate). This is especially important given the increased prevalence of refractive errors in children, particularly myopia.

Figure 2 Wet retinoscopy (after instilling cycloplegic eye drops) can help you to achieve more accurate refraction results in younger children who have active accommodation. NEPAL

References

1 Cao H, Cao X, Cao Z, Zhang L, Han Y, Guo C. The prevalence and causes of pediatric uncorrected refractive error: Pooled data from population studies for Global Burden of Disease (GBD) sub-regions. PLoS One. 2022;17(7):e0268800..
2 Yazdani N, Sadeghi R, Ehsaei A, et al. Under-correction or full correction of myopia? A meta-analysis. J Optom. 2021;14(1):11-19.
3 Yazdani N, Sadeghi R, Momeni-Moghaddam H, Zarifmahmoudi L, Ehsaei A. Comparison of cyclopentolate versus tropicamide cycloplegia: A systematic review and meta-analysis. J Optom. 2018;11(3):135-143.
4 Wygnanski-Jaffe T, Nucci P, Goldchmit M, Mezer E. Epileptic seizures induced by cycloplegic eye drops. Cutan Ocul Toxicol. 2014;33(2):103-108.
5 Webber AL, Sharwood P. Practical use and prescription of ocular medications in children and infants. Clin Exp Optom. 2021;104(3):385-395.
6 Tang S. Cycloplegic refraction. Optician. Available at **www.opticianonline.net/cpd-archive/5076**
7 Yeotikar NS, Bakaraju RC, Reddy PSR and Prasad K. Cycloplegic refraction and non-cycloplegic refraction using contralateral fogging: a comparative study. J Modern Optics 2007;54(9):1317-1324.
8 Hopkins S, Sampson GP, Hendicott P, Lacherez P, Wood JM. Refraction in children: a comparison of two methods of accommodation control. Optom Vis Sci. 2012;89(12):1734-1739.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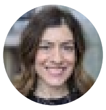
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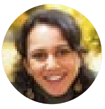
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How to assess refractive error in adults with additional or complex needs

Being flexible, calm, and sensitive to patients' needs and abilities is key to offering a patient-centred eye examination.

A 'person-centred' approach to refractive error assessment shifts the focus from treating just a refractive error or medical condition, to treating the patient as a whole person. Every person is different, so we, as practitioners, need to tailor our approach to meet the individual needs of each patient.[1]

In low- and middle-income countries, more than 1 in every 8 people have a significant disability.[2] In this article, we show how you can adapt your refractive error assessment process for adults with a range of sensory, physical, or cognitive differences (alone or in combination), which may not be immediately obvious and which the patient may not tell you about.

In low- and middle-income countries, 1 in 6 people have a significant disability. PAPUA NEW GUINEA

Types of challenges

Patients can present with a range of challenges.

For example, challenges such as reduced mobility, abnormal head posture, motor coordination issues, and/or difficulties in maintaining a fixed gaze in a certain direction may make it difficult for the patient to see the eye chart.

Being deaf or hard of hearing, or having cognitive impairment, anxiety, or attention difficulties may make it difficult for the patient to understand and respond to questions, or to follow instructions.

1. Before the examination begins

- Ensure that the examination room is fully accessible to people who use a wheelchair.
- Observe the patient entering the room. Greet them and invite them to sit down. This is an opportunity to objectively assess the patient's physical abilities and restrictions, as well as their ability to understand and follow instructions.
- Allow the patient some time to familiarise themselves with the room and the equipment.
- When the patient is settled, introduce yourself and talk to the patient in a friendly way.
- Ask a few introductory questions, such as their name, how they are, and whether they are comfortable.
- Ask the patient if they have any communication preferences. Alternatively, if you notice that they have difficulties understanding you (e.g., due to being deaf or hard of hearing, or having cognitive difficulties) ask how you can make things easier for them (see panel)
- If the patient's support person is acting as an interpreter, continue to speak to the patient directly and maintain appropriate eye contact – **do not address the support person instead of the patient**.

2. Taking a history

- Ideally, you will have received information about the patient ahead of the assessment appointment. Some organisations request that patients or their support persons complete a form in the weeks leading up to the appointment, such as this one by the charity SeeAbility: **www.seeability.org/resources/about-me-and-my-eyes**. If no information is available, and you have time, it may be worth contacting the patient or support person by phone before the appointment to get a brief history.

How to support communication and interaction with the patient

Understanding how best to communicate with your patient is vital. Ask the patient if they have any communication preferences, then allow enough time for them to answer.

When your patient is deaf, hard of hearing, non-verbal, is from a different language group, or has other communication challenges, it is important to speak clearly and slowly. If patients rely on lip reading, remove your face mask (if safe to do so), and ensure that the patient can clearly see your face when you are speaking to them. Avoid making the room too dark, and don't position yourself in front of a bright light or bright window.

If patients have cognitive difficulties, speak slowly and use short, simple sentences. You can also use gestures or pictures to explain procedures and choices, if needed.

Always speak with the patient directly, even if they have an interpreter (e.g. a sign language interpreter). Never assume that the patient cannot understand you, and don't talk about the patient to the interpreter or support person, as if the patient isn't there.

- Ask about their current prescription (if any) and whether they are able to function as they would like to, in terms of both distance and near visual tasks. Do they have any other visual symptoms?
- Ensure that patients have enough time to answer your questions before moving them on to the next question. It is important that the patient feels that you understand their needs and that you want to help them.
- A useful general question with which to end history taking is, 'Is there anything else you want to tell me?'

3. The examination

Being patient and flexible throughout the examination will help you to adapt your approach based on the patient's responses and needs. Remember to allow enough time for patients to follow instructions and answer questions.

For ease of examination, specific equipment and techniques may be needed.

Before **testing visual acuity**, find out whether patients are familiar with the alphabet; they may be more comfortable using Lea or Kay symbols or a tumbling E chart; matching cards can also be helpful. **Note:** Measuring visual acuity might not be possible or vital, so this can be elicited by asking what sort of tasks the patient does and what they can normally see. Think about what you are trying to achieve for the patient.

In terms of the **objective refractive routine**, retinoscopy is a vital skill and may be the only way to assess refraction for patients with significant physical or intellectual challenges. Cycloplegia may be recommended in young adults – see the article in this issue. If a dark room is anxiety-provoking for the patient, it is fine to keep the light on. Using loose trial lenses or a lens rack can also help to speed up the assessment. Obtaining an accurate result from this part of the routine will reduce the time spent on the subjective refraction, which will reduce the patient's fatigue.

You can simplify the **subjective refraction routine** by using larger differentials in power (e.g. plus or minus 1:00D) or fewer lens choices; this can help to make the subjective examination more meaningful. Where possible, ask questions that are easy to understand. For example, ask if the lenses reduce blur, or help the patient to see smaller letters. Moving the chart or patient closer may be helpful, particularly in cases of abnormal head posture and those with visual impairment. A 3-metre test chart is useful, and using a logMAR chart will help you to account for different working distances. When assessing astigmatism, a 1:00 DC Jackson cross cylinder (used with an appropriate visual target), with the cylinder moved in 20-degree steps, will help patients with visual impairment discriminate differences more easily.

People with additional needs are more likely to need help with near vision. When assessing near vision in someone who is unable to communicate, **dynamic retinoscopy** can be very useful.[3] It is important that any significant distance refractive error is corrected first, and that dynamic retinoscopy is done without cycloplegia.

If a patient can communicate the clarity of their near vision, then you can carry out a **subjective near vision assessment**. You can refine in 0.5D or 1.00D steps to elicit the most appropriate add at the preferred working distance. Remember that the level of clarity needed is determined by the near vision tasks a patient performs. Perfect near vision is not always needed.

If the patient is of presbyopic age (usually over the age of 40), their age can be used to estimate the likely starting point for the level of add needed.[4]

In patients with **low vision**, a high reading add of +4.00D or more can be used; however, the shorter working distance needs to be emphasised. Base-in prisms need to be considered to aid convergence for higher adds. A low vision aid may be more appropriate, this might require referral to a low vision service.

Tips for reducing patients' anxiety

- Allow enough time for the examination so that you are not rushed. If you are calm, the patient is more likely to feel calm.
- It may be helpful to modify the testing environment to suit the patient's needs. For example, you can change the lighting (not too bright, and not too dark), reduce distractions, and plan or suggest breaks from testing.
- Explain each step of the examination process as you perform them, in simple, non-technical language – this helps to build trust. You can do this even if you're not sure how much the patient understands.
- If the patient has a cognitive impairment, a useful way to reduce their anxiety can be to carry out an examination task or test on their support person first; this helps them to feel more familiar with the situation and understand what is expected.

After the examination

It is important to involve the patient in the decision-making process following the findings of the refractive examination. For example, if they require both near and distance vision correction, would they prefer to have different spectacles for each type of task, or would bifocal/progressive lenses work better for them? See the article on patient education in this issue for more information.

Respect patients' preferences and consider their capabilities when suggesting solutions. If needed, additional recommendations around lighting, colour, and contrast may also be helpful to enable patients to make the most of their sight in different environments.

It may be useful to write down your findings to help the patient and/or support person remember your recommendations; for example, detailing which spectacles or low vision aid is used for each visual task, while also checking the availability and affordability of each device, and explaining where to get it and what funding may be available to help with the costs, if needed.

In order to plan follow-up, it is very important to understand the patient's circumstances in coming for their eye examination. For example: Have they come from a long distance? Has their support worker needed to give up a day's paid work in order to accompany them? Has the visit created a large financial burden? Can the patient be seen locally, or is a mobile eye team visit planned to the patient's area?

Provide clear instructions for any follow-up care, together with contact details in case there are any further questions; this will help to reduce anxiety and make it possible to address any issues that may come up in future.

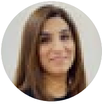
References

1 Donaldson L. Adapting sight tests for patients with special needs. Optometry Today. 2021. Available at: **tinyurl.com/adapting-sight**

2 Global report on health equity for persons with disabilities. Geneva: World Health Organization; 2022. Available from: **tinyurl.com/WHOglobaldisability**

3 Enaholo ES, Musa MJ, Zeppieri M. Objective Refraction Technique: Retinoscopy. [Updated 2023 Oct 28]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan. Available at: **tinyurl.com/objective-refraction**

4 Han X, Lee PY, Liu C, He M. Distribution and progression of add power among people in need of near correction. Clin Exp Ophthalmol. 2018;46(8):882-887



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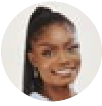

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Prescribing and fitting spectacles: the role of pupillary distance and the optical centre

To ensure clear vision, it is vital that the optical centre and pupils are aligned correctly.

Figure 1 Marking the position of the pupil on dummy lenses. MOZAMBIQUE

The optical centre (OC) of a spectacle lens is the point at the centre of the lens through which light rays pass without any unwanted prismatic effects (displacement of the image). In other words, the optical centre of a lens is the point at which the wearer will experience the clearest vision.

It is therefore crucial for the optical centre to be correctly aligned with the wearer's pupils, so they can see clearly, no matter which direction they look in. If the optical centre is not correctly aligned, light rays that pass through the lens are refracted, or bent, which leads to blurred or distorted vision. This can cause the patient to experience eye strain, discomfort, and headaches.

The optical centre also plays an important role when prism is prescribed, usually for patients who have difficulty combining the images received from both eyes. Prisms can be created by decentring the lens in the frame; i.e., moving it so that the patient looks through the lens at a point away from the optical centre.

Monocular or binocular pupillary distance?

It is standard practice to measure and record both monocular and binocular PDs for each patient. Monocular PD is often recommended for greater accuracy in prescribing because most people have asymmetrical faces; i.e., our left and right pupils are not always the same distance from the centre of our nose. This asymmetry can result in wrong placement of the optical centre and induces prismatic distortion.

Table 1 When to measure monocular and binocular pupillary distance

	Monocular pupillary distance?	Binocular pupillary distance?
High prescription OR high facial asymmetry	Yes	No
Bifocal or progressive lenses	Yes	No
Squint	Yes	No
Low prescription + minimal facial asymmetry	Not needed	Usually sufficient
If the patient is a baby or young child	Not needed	Usually sufficient

1. Measuring pupillary distance

The first step in achieving correct alignment of the optical centre is to accurately measure and record the pupillary distance, measured in millimetres (mm). Depending on the circumstances and the patient (see panel) this can be either the **binocular** pupillary distance (the distance between the centres of the two pupils), or the **monocular** pupillary distance: the distance between the centre of the pupil and the centre of the nose, recorded for each eye separately (see panel).

These are the measurements the laboratory will use when fitting lenses to the patient's chosen frame. If the pupillary distance is measured incorrectly, the optical centre will be incorrectly set within the spectacle frames, which can only be rectified by remeasuring the pupillary distance correctly, and remaking the spectacles.

NOTE: It is important to guide patients in their choice of frame. If the frame is too big or too small, or if it has been poorly adjusted, this can lead to misalignment of the optical centre, even when the pupillary distance has been measured correctly.

What you will need:

- A pupillary distance ruler

Before you begin:

- Wash your hands and tell the patient what you are going to do.
- Position yourself directly in front of the patient, ensuring that you are at the same height as them, and about an arm's length in distance.

Measuring the binocular pupillary distance

1. Holding the ruler between your thumb and forefinger, place the ruler so that it is resting on the bridge of the patient's nose and forehead. Use your middle finger to steady your hand on their head.
2. Close your right eye and ask the patient to look towards your open left eye.

3 Place the zero reading of the ruler so that it is aligned with the centre of the patient's right pupil.
4 Keeping the ruler in this position, close your left eye and ask the patient to now look towards your open right eye.
5 Read the measurement that aligns with the pupil centre of their left eye. This is the binocular pupillary distance.
6 If the patient has very dark irises, making it difficult to see the pupil, you can measure from the temporal edge of the right iris to the nasal edge of the left iris, using the same technique.
7 Record this distance in the notes.

B. Measuring the monocular pupillary distance in each eye

1 Measure from the centre of the right pupil to the centre of the patient's nose and record the **right monocular pupillary distance** in the prescription notes.
2 Measure from the centre of the nose to the centre of the left pupil and record the **left monocular pupillary distance** in the prescription notes.

2. Marking the pupillary distance on the dummy lenses

In situations where a progressive lens is prescribed, in particular, it is important to measure and mark the position of the pupil on the dummy lenses in the frame the patient has chosen. This will ensure that the wearer is looking through the right part of the lenses for distance, intermediate, and near vision.

1 The patient should wear the frame chosen at the position they would be comfortable wearing their spectacles.
2 Sit in front of the patient and ask them to look straight ahead.
3 Position yourself with your eyes level with the patient's.
4 When marking the right lens, tell the patient to look towards your open left eye, and vice versa.
5 Keeping you head still, make a dot on the dummy lens directly in line with the centre of the pupil (Figure 1).

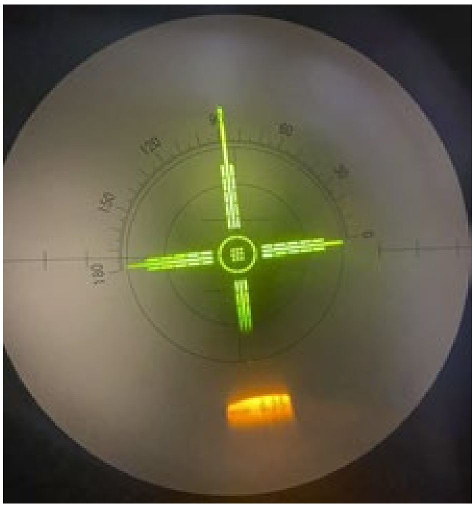
3. Finding the optical centre

Once spectacles come back from the laboratory, and before fitting the frame on the patient, the next step is to find the optical centre. There are two ways of doing this:

a. Locating the optical centre using a focimeter.
You can use a focimeter to locate the optical centre of a lens if you have access to one, using the following steps.

1 First focus the machine. Turn the eyepiece fully anticlockwise. Then, while looking into the focimeter, turn the eyepiece clockwise until the graticule seen inside is just clear. At this point, the focimeter is focused for your eye.
2 Check the calibration of the focimeter by turning the power wheel on the side until the target is completely clear. If, at this point, the reading of the power is at 0.00D, then your machine is correctly calibrated. If not, then this would need to be taken into account when using the focimeter to measure a spectacle prescription.
3 Place the spectacles in the focimeter so that they are facing away from you and completely flat on the frame table.
4 To locate the optical centre, move the spectacles up, down and side to side, while looking through the eyepiece, until the target (in green) is in the centre of the black graticule (Figure 2).
5 Now you can clamp the spectacles in place using the spectacle clamp.
6 Mark the optical centre using the marking device found on the right-hand side of the focimeter.

Figure 2 The optical centre has been located using a focimeter



It is usually good practice to begin with the right lens first, and then move on to the left lens, in order to maintain consistency.

b. Locating the optical centre using hand neutralisation
If you do not have access to a focimeter, you can use hand neutralisation to locate the optical centre of a spectacle lens, using the following steps:

1 Draw a cross on a piece of paper, with the lines at 90 degrees to each other, and stand it up against a wall.
2 Look at the cross through the lens on which you are locating the optical centre, while holding it about arm's length away (Figure 3).
3 Move the lens up, down, left, and right, and turn it clockwise and anticlockwise – until the lines that you can see through the lens are exactly in line with the lines that remain outside the lens (Figure 4).
4 When you have reached this point, the centre of the cross will indicate the optical centre. You can then mark this using a fine marker pen.

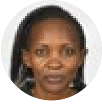
Figure 3 Lens not quite aligned with a cross chart

Figure 4 Lens aligned with a cross chart

4. Fitting spectacles

The final step is to adjust the spectacles to ensure a good fit and check that the optical centre – now marked on the spectacles – matches the patient's pupils.

Regular adjustment of spectacle frames, to ensure a good fit, will ensure that the optical centres are always correctly aligned with the patient's pupils.



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Talking to patients about their new spectacles

Educating patients, listening to their concerns, and offering guidance and reassurance will enhance their overall experience of wearing spectacles.

Many people feel apprehensive when they are first told that they need a pair of spectacles. Here are some common examples we have come across, and ideas for addressing them.

- **Long-term use of spectacles**. Some patients feel if they wear spectacles for a long time their eyes may become sunken; reassure them that spectacles do not affect the anatomy of the eye.
- **Cosmetic appearance.** Some patients worry that the spectacles may not look good on their face; the person dispensing should provide a mirror to the patient while selecting the frames so they can reassure themselves about their appearance.
- **Effect of spectacles on vision.** Some patients are hesitant to wear spectacles, claiming that their vision might deteriorate. Assure them that the spectacles will improve their sight and that wearing corrective lenses will not make their vision worse in the long term.

When dispensing spectacles

It is normal for people to experience some initial discomfort when they start wearing spectacles. Without the correct information and support, some patients may stop wearing their spectacles before they can benefit from the improvements in their vision the spectacles provide.

Therefore, when patients try on their new spectacles, take a moment to talk to them about the following (as appropriate):

- **Peripheral blurring due to the frame**. Some patients may experience blurring in their peripheral vision due to the edge of the frame. Reassure them that this effect becomes less noticeable over time
- **Depth perception.** Patients may experience temporary issues with depth perception whilst their eyes adjust to the new corrective lenses. Reassure them that they will adjust to this quickly.
- **Distortion.** This may be noticed more with strong prescriptions; patients may report a 'fishbowl' effect or other visual distortions which make them feel uncomfortable or disoriented, particularly if it's a new prescription or a different lens design. Again, assure them that this will becomes less noticeable over time, as they adjust.

Before patients take their spectacles home

Ideally, patients should return for a check-up after one year. Explain to patients that they may need to come back sooner if they are unable to adjust to the prescription, if the spectacles break, or if they notice a change in their vision.

Put spectacles on and take them off using both hands to avoid tension on one side of the frame. KENYA

Some patients believe that spectacles 'expire' after a certain amount of time. Before the patient goes home, explain that the lens, when properly taken care of, will continue to work. Any changes in vision they experience may be due to scratches on the lens surface, or because there has been in a change in their vision.

Encourage patients to care for their spectacles (see panel) and to return for eye tests at regular intervals, depending on the nature of their condition. Remind patients to avoid sharing spectacles with relatives or friends as the prescription will be different and the user is likely to experience worsened vision and other symptoms, such as headaches or dizziness, as a result.

Patients who need correction for both distance and near vision

Some patients may have specific visual requirements for both close work (such as reading or sewing) and distance vision (such as driving or seeing objects that are far away).

There are two main options for these patients:

1 Prescribing two (or more) separate pairs of spectacles – e.g., one for near vision and one for distance vision.
2 Prescribing bifocal (Figure 4) or progressive lenses – these provide two or more optical powers in a single lens, so that the patient has more than one working distance. Bifocal lenses have a visible horizontal line where the two lens powers meet; in progressive lenses there are no visible lines.

Advice for patients: how to care for your spectacles

By following these guidelines, your spectacles will last longer and the lenses will remain clear.

1 Use both hands when putting on or removing your spectacles to avoid bending the frames. The arm may also become loose on one side or may even break if taking on and off using just one hand.
2 Avoid harsh cleaners. Clean the lenses with mild soapy water or lens cleaner (specifically designed for spectacles) and dry them with a microfibre cloth (Figure 1). Avoid using clothing, tissues, or paper towels as these can scratch the lens surface.

Figure 1 Use a microfibre cloth. Avoid using clothing, tissues, or paper towels as these can scratch the lens surface.

3 Avoid exposing your spectacles to hairspray, perfumes, or other chemicals.
4 If your spectacles feel loose or uncomfortable, visit an optician who can adjust them. You can regularly check for any loose screws and tighten these gently, if needed.

Storing spectacles

1 Always store your spectacles in a hard-shell case for added protection. Ensure the lenses are lying on the microfibre cloth and the frame arms are facing upwards; this avoids damage to the arms (Figure 2).
2 Keep spectacles away from direct sunlight and extreme temperatures. For example, avoid placing them on a windowsill or on the dashboard of a moving vehicle; heat from the sun or the engine may damage the coating of the lenses and cause the frames to expand.
3 In case you need to place the spectacles on a surface without the storage case, ensure the arms of the frame are placed on the surface while the lenses are facing upward; this prevents the lenses from getting scratch marks (Figure 3).

Figure 2 How to store spectacles in a case: lenses down, with the arms uppermost.

Figure 3 Place the spectacles on a surface with the lenses facing upwards.

Advice for patients who need correction for both distance and near vision

How to use separate pairs of spectacles

1 Wear your distance vision spectacles as advised by your practitioner, especially if they are needed for driving.
2 Only wear your near vision spectacles for near vision tasks such as reading, sewing, writing, drawing, cooking, or food preparation.

How to use bifocal or progressive spectacles

1 Look through the upper part of the spectacles to see objects in the distance, such as road signs.
2 Look through the lower part of the lens for tasks that require near vision, such as reading, sewing, writing, drawing, cooking, or food preparation.
3 If you have progressive lenses, look through the middle part of the lens to see objects in the middle distance, e.g., when working on a computer.
4 Take care when walking up or down steps or stairs. You may need to bend your head down so that you can look through the upper part the lenses. If you look through the lower part of the lenses, you may fall as the image may be blurred; the stairs may also appear nearer than they really are.

Figure 4 Bifocals

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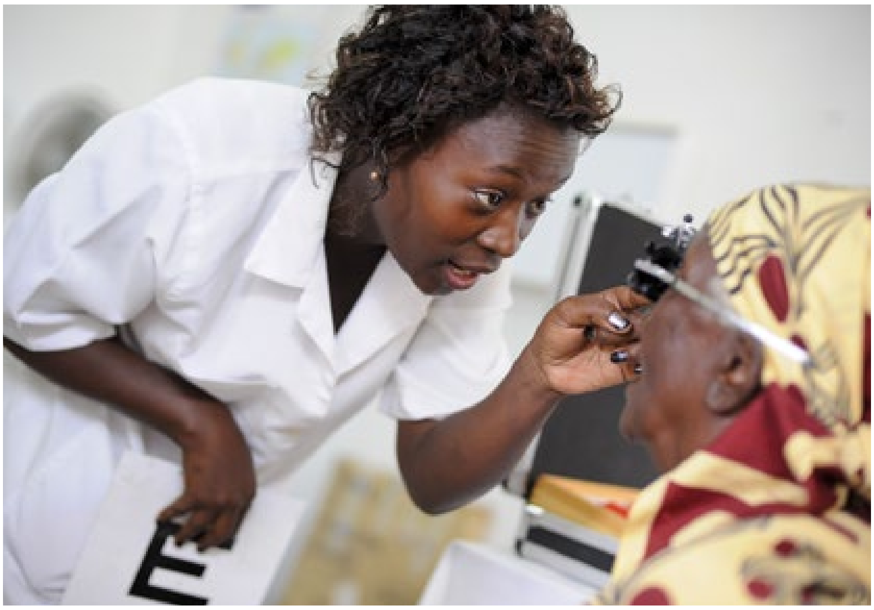
Caring for refractive error equipment

The success of a community refractive error service depends on having well-maintained equipment that is in good working condition.

In this article, we present a list of the equipment commonly used to provide refractive error services in lower-resource settings, along with guidance on care and maintenance. Where available, we have added links to previous articles in the *Community Eye Health Journal*.

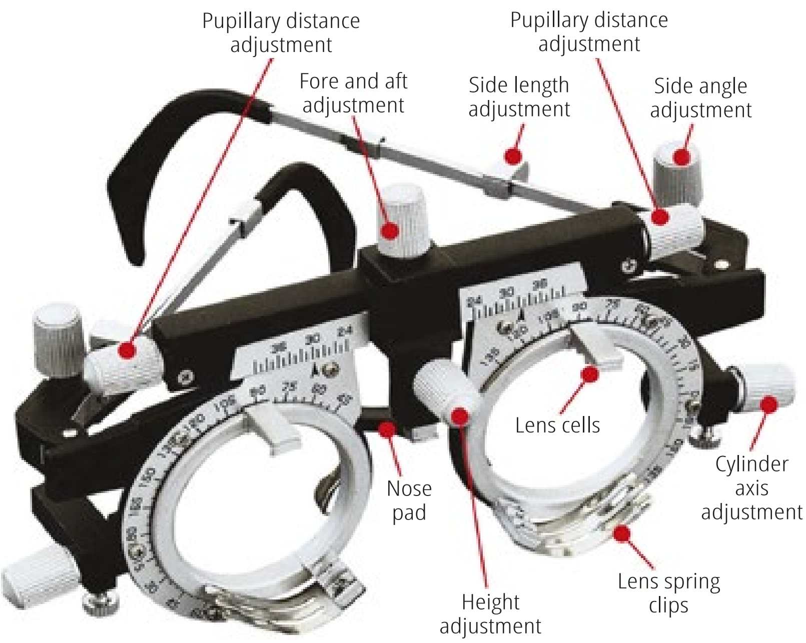


Refractive error examination. MOZAMBIQUE

Distance visual acuity charts. These charts have lines of optotypes (characters) of various sizes and are used to determine visual acuity at different distances. The Snellen chart displays letters or symbols at a standardised distance (usually 20 feet or 6 metres). Visual acuity is measured based on the smallest line a patient can read accurately at that distance. For patients who have difficulty recognising letters, a tumbling E chart may be used; this uses the letter 'E' in various orientations. Distance visual acuity charts are used during refraction to establish the best corrected distance visual acuity.

Near visual acuity charts. Near vision charts can consist of paragraphs of text with different font sizes, or they can consist of lines of numbers or tumbling Es in different sizes. These are used to check near vision at a normal near working distance for the patient (typically 40 cm).

Figure 1 Components of a trial frame



Tape measure. Used to measure the distance between the patient and the near eye charts. This can help demonstrate to patients the closer working distance required for high positive lenses that may be needed to read ore perform close tasks at near.

Occluder. An occluder is used to cover one eye while the other is being tested.

Pinhole. A pinhole provides a simple way to focus light temporarily removing the effects of refractive error such as myopia.

Cross cylinders. Used to refine astigmatic prescriptions subjectively. The Jackson Cross Cylinder (JCC) consists of two cylinders at right angles to each other; by rotating the cylinder and observing the patient's responses to different lens orientations, the optometrist can determine the precise cylindrical power and axis needed to correct the astigmatism present.

Trial lens set and trial frames. A trial lens set contains lenses of different powers which can be temporarily placed in a trial frame (Figure 1). This enables the practitioner to determine the appropriate prescription for glasses using both objective and subjective methods. Initially, the lenses are used to accurately and objectively estimate the amount of refractive error present. The trial lenses are then used to subjectively refine the refractive error. **Trial frames** hold the trial lenses over each eye. For more information on their function and care, read our article, '**Understanding and looking after a retinoscope and trial lens set**' (**tinyurl.com/CEHJ-retino**).

Pupillary distance ruler. Used to measure the distance between the pupils.

Lensmeter. Also known as lensometer or focimeter, it is used to measure the prescription of a pair of eyeglasses. For more information read our article, '**Understanding and caring for a lensmeter**' (**tinyurl.com/CEHJ-lensmeter**).

Ready-made spectacles. These pre-made glasses have the same powered lens on each side and can be dispensed immediately. These are useful where limited resources do not permit custom-made spectacles.

Retinoscope (Figure 2). This is a handheld instrument which shines a light into the eye – the reflection is observed and used to assess the amount of refractive error. It provides an objective method of refraction in which the patient does not need to tell the practitioner what they see. For more information, read our article, '**Understanding and looking after a retinoscope and trial lens set**' (**tinyurl.com/CEHJ-retino**).

Autorefractor. A computerised device which can be used to objectively estimate a person's refractive error. Care needs to be taken when using these devices, particularly with children, as the accuracy of the results can be affected by accommodation.

General care and maintenance

To ensure the proper operation, and to get the longest life from your refractive error devices, there are some essential practices that you should follow.

1 **General cleaning**
   - Some surfaces may be damaged by harsh cleaners and alcohol. Only use the cleaning solutions recommended by the manufacturer.
   - Keep instruments covered when not in use.

2 **Battery maintenance.** Batteries should be managed to ensure that medical devices are always ready for use. Here are a few tips:
   - Follow manufacturer guidelines.
   - Store the battery separately from the device if is not being used for a long time.
   - Keep an inventory of spare batteries.

3 **Cleaning lenses and optical surfaces.** Many ophthalmic devices have optical components such as windows, lenses, mirrors, filters, and prisms; these need to be protected and cleaned. For more information read our article, '**How to care for and clean optical surfaces**' (**tinyurl.com/CEHJ-cleanopt**).

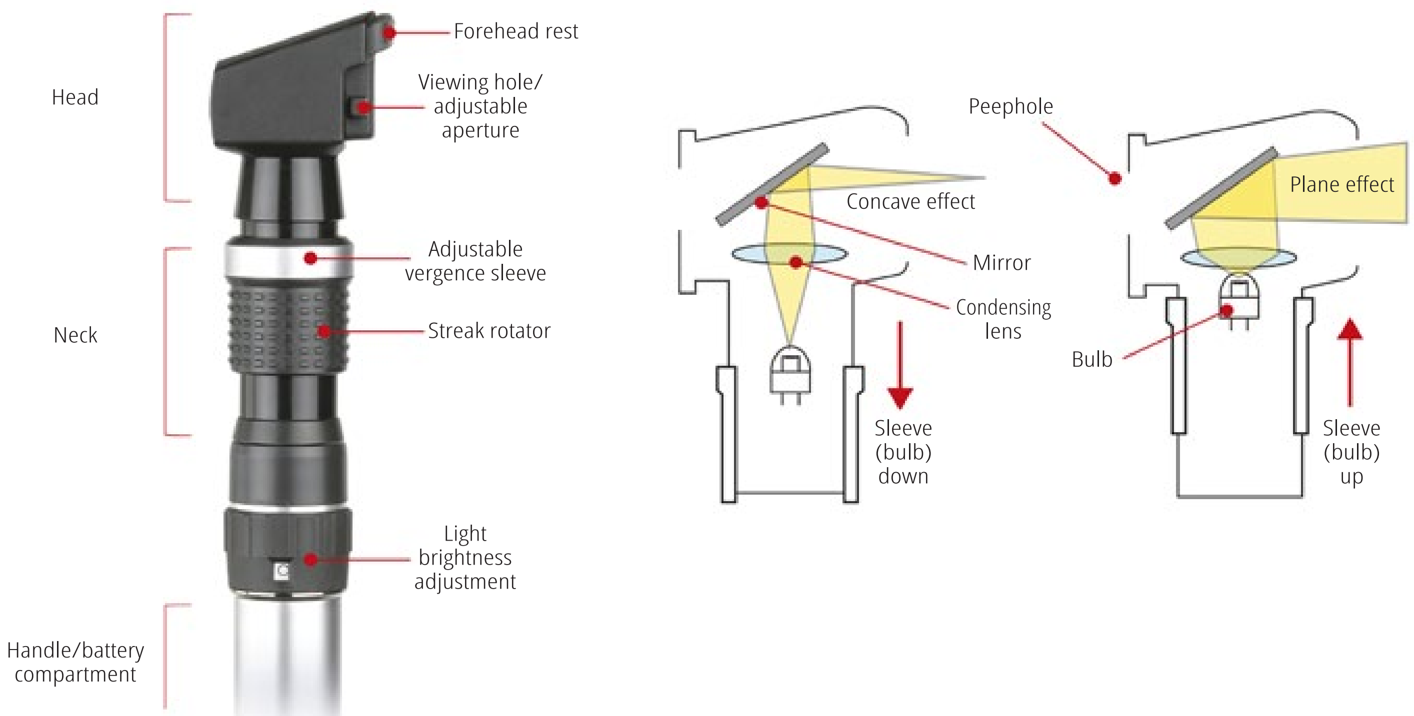
4 **Prevention of fungal growth on optical components.** In hot and humid climates, it is common for mould to grow on the surfaces of optical components. Precautions should be taken to prevent this. For more information read our article, '**Fungus: how to prevent growth and remove it from optical instruments**' (**tinyurl.com/CEHJ-fungus**).

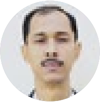
5 **Bulb maintenance.** Many devices used in eye care rely on light bulbs or lamps for their operation. All light bulbs have a limited lifespan, and when the bulb fails the device becomes unusable. Therefore, knowing how to handle, inspect, and replace bulbs is important. Always maintain a supply of replacement bulbs for your equipment and only use those recommended by the manufacturer. For more information read our article, '**How to handle and care for bulbs in ophthalmic equipment**' (**tinyurl.com/CEHJ-bulbs**).

6 **Fuse maintenance.** Fuses play an important safety role in preventing damage to equipment due to electrical overloading and reducing the risk of electrical shock to patients and staff. For more information read our article, '**Checking and replacing fuses**' (**tinyurl.com/CEHJ-fuses**).

7 **General electrical safety practices.** For more information read our article, '**Electrical safety in the clinical environment – good habits to maintain**' (**tinyurl.com/CEHJ-electric**).

Figure 2 Components of a streak retinoscope





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Strengthening access to refractive error services in a remote district of Assam, India

The vision centre approach has increased access to refractive error services at the level of primary eye care in a remote area in India.

Near vision examination of a patient at Barpeta Vision Centre, Assam. INDIA

Refractive error is one of the major causes of visual impairment amongst all age groups and genders in India.[1] Key factors include insufficient awareness, a shortage of skilled human resources, and a lack of adequate evidence about effective approaches to address refractive error, especially in remote settings.

The Barpeta Vision Centre was set up in February 2022 as a partnership between Mission Jyoti, a Mission for Vision initiative, and Sri Sankaradeva Nethralaya, an eye hospital in Guwahati in the north-eastern state of Assam, India. Its aim is to address the burden of visual impairment in Barpeta, a remote district of Assam, by offering affordable primary eye care services.

Before the vision centre was established, people with refractive errors could access services only during the cataract screening camps organised by Sri Sankaradeva Nethralaya, or by traveling 90 km to the nearest tertiary eye centre in Guwahati. People who needed spectacles had to buy them from local optical outlets at rates that were unaffordable for the majority.

The vision centre serves a population of about 50,000 and is located in rented premises with an area of 340 square feet, in the market area of Barpeta town. People from surrounding villages, within a radius of 15 to 20 km, come to Barpeta market for various purposes and can then also access eye care facilities at the vision centre. The vision centre also organises two or three community camps each month in villages within a radius of 5–8 km from Barpeta. During these camps, screening, identification, and referral services are provided. Patients identified with cataract are referred to the tertiary eye centre in Guwahati for surgery, and those who require spectacles and/or further examination are referred to the vision centre in Barpeta.

For the local communities, the distance to be covered and travel time required to access services such as basic eye examination, refraction test, identification of cataract and other conditions, and dispensing of spectacles have therefore been considerably reduced.

Human resources

The vision centre is staffed by an optometrist and two female community health workers. It is overseen by a co-ordinator who is responsible for managing other community activities conducted by Sri Sankaradeva Nethralaya in the area.

The community health workers and the co-ordinator are trained by, and affiliated to, the tertiary eye facility in Guwahati. The clinical staff are trained as part of a university-recognised course at Sri Sankaradeva Nethralaya.

The community health workers conduct door-to-door screening and refer patients as needed; interact with various stakeholders such as heads of schools, teachers, staff of primary health centres, and local community leaders; and organise community eye camps and vision screening programmes in schools. The female health workers interact with women during the door-to-door visits, talk to them about the vision centre and its services, and create awareness among women about the need for eye care for themselves and their children.

Services

The services offered by the vision centre include the following:

- door-to-door screening within the catchment area, with referrals as needed
- counselling of patients
- refraction services and dispensing of spectacles
- diagnosis of cataract and other common eye

conditions, and referral to the hospital in Guwahati

- postoperative follow-up
- school eye health services, which include screening school children in the catchment area, providing free spectacles to children identified with uncorrected refractive error, and referring those who require further diagnosis and treatment to the base hospital
- eye health information and education services to raise community awareness of the need for regular eye check-ups.

The centre is compliant with the World Health Organization's guidelines for conducting vision and eye screenings in community and primary care settings [2] and is equipped to assess refractive error and cataract.

Provision of spectacles

The vision centre stocks spectacles varying in quality and price. The lowest-priced spectacles cost INR 450 (approximately US $5) compared to INR 750 (approximately US $9) at the local optical outlets; this makes them more affordable to people on lower incomes. The most expensive pair at the vision centre would cost INR 900 (approximately US $11) compared to INR 3,000 (approximately US $38) in shops outside. Spectacle lenses are made and fitted at the grinding and fitting workshop at the base hospital and delivered to the patients through the vision centre, with a turnaround time of three to four days.

Financial viability

The vision centre charges each new patient a registration fee of INR 100 towards eye examination, diagnosis, and referral (if required). This is valid for one month, during which period additional visits are not charged. The registration fee is waived for patients who cannot afford to pay it.

The financial viability of the vision centre is ensured through the registration fee and the sale of spectacles. These income streams meet the direct running cost of the vision centre and contribute to the sustainability of services. Apart from the registration fee, there are no other charges for patients for eye care services at the vision centre. The costs are covered by Sri Sankaradeva Nethralaya, with funds generated from patients opting to pay for surgery packages being used to cross-subsidise patients who cannot afford to pay. Thus, the cost of the services is never a burden on those who cannot afford them.

Trends in access to services at the vision centre

Over the 23 months since it was established, the vision centre has shown a steady increase in uptake of services. Starting with 42 people in February 2022, the vision centre now serves around 460 people each month. Notably, 85% of those prescribed spectacles prefer to buy them from the vision centre, with the rest choosing to procure them from other optical outlets.

Increasing women's access to eye care is one of the key aims of the vision centre. Of the beneficiaries who were screened at the vision centre in Barpeta and its community camps, 58% were women. About 56% of those who received spectacles and 57% of those who underwent surgery through the vision centre were women.

Networks

The vision centre has established networks with local government functionaries, officials from the health, education, and social welfare departments, and key stakeholders at various levels to ensure increased uptake of services. Whereas the vision centre personnel have close links with organisations at the local panchayat level, the base hospital team is supported by networking with the district-level government authorities. The centre's female health workers closely interact with various stakeholders in the community.

Success factors

Even though the Barpeta Vision Centre has been operational for less than two years, an increasing number of people, particularly women, have access to quality primary eye care. This has been achieved by

- offering comprehensive eye care services
- strengthening the eye health workforce in a remote location through the provision of trained personnel
- engaging with people and communities
- prioritising the provision of services to vulnerable populations, primarily children and women
- integrating eye health into the wider health system through networking and referrals
- fostering linkages with the tertiary facility, local community-based organisations, and NGOs.

Over the past 23 months, this initiative has highlighted the value and utility of the vision centre approach in providing people-centred, affordable, and comprehensive eye care, including refractive error care, in a remote area. Other instances of successful outcomes of the vision centre approach in India have also been documented. [3]

References

1 Government of India, Ministry of Health and Family Welfare. National blindness and visual impairment survey 2015–2019 [Internet]. Available from: https://tinyurl.com/yzz5zfmm

2 World Health Organization. Department of Noncommunicable Diseases. Vision and eye screening implementation handbook [Internet]. Geneva: World Health Organization; January 2024. Available from: https://tinyurl.com/36mxbv4p

3 Khanna RC, Sabherwal S, Sil A, Gowth M, Dole K, Kuyyadiyil S, et al. Primary eye care in India– the vision centre model. Indian J Ophthalmol. 2020;68(2):333-9.