中山大學
中山眼科中心
ZHONGSHAN OPHTHALMIC CENTER, SUN YAT-SEN UNIVERSITY

Contents lists available at Lighthouse Scholar

EYE SCIENCE

journal homepage: journal.gzzoc.org.cn

doi: 10.12419/es26030101

View this article at: https://doi.org/10.12419/es26030101

• Editorial •

Eyes on the burden: rethinking eye health in the GBD era

Nathan Congdon[1,2,3], Hossein Farrokhpour[4], Brad Wong[5,6]

1. Centre for Public Health, Queen's University Belfast, Belfast, United Kingdom.
2. Orbis International, New York, United States of America.
3. Zhongshan Ophthalmic Centre, Sun Yat-Sen University, Guangzhou City, China.
4. Translational Ophthalmology Research Center, Farabi Eye Hospital, Tehran University of Medical Sciences, Tehran, Iran.
5. Mettalytics, New South Wales, Australia.
6. Seva Foundation, Berkeley, California, USA.

Cite this article as: Nathan Congdon, Hossein Farrokhpour, Brad Wong. Eyes on the burden: rethinking eye health in the GBD era. Eye Science. 2026, 3(2): 59-68. doi: 10.12419/es26030101.

In response to the heavy burden of vision impairment and blindness, global commitment to eye health has intensified over the past three decades, giving rise to a series of increasingly sophisticated frameworks and initiatives. VISION 2020, launched in 1999, was one of the first coordinated global agendas targeting avoidable blindness, followed by the Global Action Plan 2014-2019,[1] which set an ambitious target of a 25% reduction in avoidable vision impairment, a goal that was not fully met.[2] More recent efforts include the World Report on Vision, which introduced Integrated People-Centred Eye Care (IPEC),[3] and the Lancet Global Health Commission, which demonstrated eye health's role in reducing poverty, improving productivity, strengthening education and gender equity, and enhancing wellbeing and social inclusion, thereby establishing it as a core component of universal health coverage and the Sustainable Development Goals (SDGs).[4]

This growing recognition, together with calls for global action, culminated in the historic adoption of the United Nations (UN) General Assembly Resolution "Vision for Everyone: Accelerating action to achieve the SDGs", the first-ever UN resolution on vision. It calls on Member States to integrate eye health into national development agendas, primary

Received date: 2026-03-01; **Revised date:** 2026-03-25; **Accepted date:** 2026-05-07; **Published online:** 2026-06-23

Corresponding author: Nathan Congdon, E-mail: ncongdon1@gmail.com.

Full Text

health care, education, labour, and financing systems, marking an unprecedented global political commitment to universal eye health.[5-6]

During this period, systematic assessment of the vision loss burden has been essential not only to evaluate the effectiveness of public health interventions but also to inform stakeholders, governments, and other responsible parties in evidence-based policy development. The Global Burden of Disease (GBD) Study, an Institute for Health Metrics and Evaluation (IHME)-led global modelling effort, represents one of the most comprehensive tools for quantifying spatiotemporal health loss and has been instrumental in providing a standardized data platform to support this goal.[7-9] Importantly, GBD's vision estimates are produced in collaboration with the Vision Loss Expert Group (VLEG) and GBD collaborators, ensuring they reflect the broadest available population-based evidence.[2,4,10-17] In this editorial, we set out to examine how GBD data can further enhance public health practice in eye care and outline pragmatic research directions and policy implications.

In 2020, an estimated 1.1 billion people had some form of vision loss, with a projection reaching 1.8 billion by 2050 and significant heterogeneity across countries.[10] While this provides valuable insights, moving from descriptive statistics to hypothesis-driven research is critical to making full use of these rich datasets. It is important to appraise the impact of public health interventions on the burden of eye disease, including whether countries with national eye health programs show corresponding lower burdens of vision loss.

Three decades of coordinated global action and policy momentum have accelerated progress in eye health research and implementation, although challenges persist in terms of quality and heterogeneity across regions. According to the systematic review conducted by The Lancet Global Health Commission on Global Eye Health, between 2000-09 and 2010-19, global peer-reviewed eye health output increased by 50%, from 62,868 to 94,086 publications. However, only 4% were trials, of particular importance in informing policy-makers, and nearly 75% originated from high-income countries, which comprise only an estimated 16% of the global population. Of all countries, China tripled its published output from 3,602 to 10,594 papers. This leaves major evidence gaps in low- and middle-income countries (LMICs), which paradoxically require the most attention, given that 90% of the vision impairment and blindness burden falls there.

Evidence presented at the Seventieth World Health Assembly showed a meaningful increase in national planning: 56 member states had established a national eye health plan or aligned strategies, and over 50 reported that a national coordinating committee was crucial for implementation.[3] This widespread adoption highlights the global shift toward structured national strategies, providing a basis to investigate whether countries with such plans have achieved more pronounced reductions in vision loss.

In a multi-country assessment of national eye health strategies, Ramke et al. contacted 88 national coordinators, World Health Organization (WHO) regional offices, International Agency for the Prevention of Blindness (IAPB) partners, and non-governmental organizations (NGOs) to identify existing national plans.[18] Ultimately, they identified 28 plans that met their inclusion criteria. Most plans relied heavily on population-based surveys, with 23 countries (82%) citing survey data, primarily from rapid assessment of blindness (RAAB), and 21 countries (75%) planning to conduct future surveys. Although RAAB, which has also been an important source of GBD vision loss data,[19] has expanded rapidly, its usefulness for national monitoring is limited, since most surveys remain subnational and are infrequently repeated. Importantly, the report noted inconsistencies in how countries use available evidence when drafting these plans. Although population-based survey data were available for multiple countries, these indicators were translated into measurable targets, monitoring frameworks, or actionable strategies unevenly. This disconnect between available data and how it informs policy underscores the need for data-driven and evidence-based approaches to link investments and strategies to quantifiable reductions in vision loss.

Individual experiences from Oman, Pakistan, and Nepal provide insights into how national eye health strategies can succeed when tailored to local systems. They also highlight the need for strong measurement frameworks to assess real-world impact. Oman cut active trachoma from 70–80% in the 1970s to 7% by 1983, becoming the first country certified trachoma-free in 2012, largely through nationwide integration of eye care into primary health services.[3] Between 2004 and 2021, Pakistan, through successive evidence-based five-year national plans, saw a three-fold reduction in blindness among adults over 50 from 6% to 2%, a decrease in uncorrected refractive error from 73% to 12%, and an increase in spectacle coverage from 15% in people aged 30 and older to 80% in those aged 50 and older.[20-22] Nepal, one of the early adopters of VISION 2020, ranks among the countries with the most exemplary records in improving effective cataract surgery coverage (eCSC).[23] It also lowered its national blindness rate from 0.84% to 0.35% from 1981 to 2010, expanded its ophthalmologists from 7 in the 1980s to 400 in 2020, built more than 100 eye care facilities by 2010, and eliminated trachoma through a mix of public and private partnerships.[24] However, despite these achievements, it still faces disparities due to limited primary care integration and reliance on NGO community eye centers.[24]

China's experience illustrates the complexity of assessing the impact of national eye health investments, particularly during periods of rapid demographic change. China's strong commitments and large-scale programs have included a national eye health plan, currently in its 15th phase, and comprehensive cataract control projects, including Sight First China Action and the One Million Poor Cataract Patients Restoring Vision.[25] Still, the total burden of vision loss has continued to increase: from 1990 to 2019, the number of blind people grew by 64%, and those with severe vision impairment rose by 147%, largely driven by population ageing rather than worsening age-specific rates.[26] At the same time, China has achieved notable successes, including eliminating blinding trachoma as a public health issue[27] and increasing the CSR from 370 per million in 2000 to 2,205 per million in 2017,[28] with the CSR surpassing 3,000 by 2020,[29] and reaching 3,684 by 2024, driven largely by widespread capacity building for cataract surgery, particularly at the county level, alongside substantial expansion of the private eyecare sector.[26] Aier, as the largest private chain of eye hospitals in China, exemplifies this trend, accounting for approximately 10% of the national total of over 4 million cataract surgeries performed in 2022.[30] Nevertheless, gaps remain: regional heterogeneity is substantial, with a recent systematic review demonstrating cataract prevalence of 28.8% in rural areas and 26.7% in urban areas among the population aged 50 years and older in China.[31] However, a relatively similar prevalence does not imply similar access or outcomes, as rural populations may face greater barriers to timely, high-quality surgery, postoperative care, and refractive correction.[32] In this context, GBD's subnational estimates can help unmask rural–urban and provincial inequities, showing that large national investments and rising CSR do not necessarily translate into uniform public health gains across all regions.[33-34] GBD 2019 data show that the eastern and central regions generally have lower severe vision impairment prevalence, while Xizang and Yunnan remain high in terms of blindness, and several provinces rank among the highest for moderate to severe vision impairment.[26] Additionally, uncorrected refractive error is now the main cause of moderate and severe vision impairment, and cataract remains the leading cause of blindness and the second cause of severe vision impairment. From 1990 to 2019, the proportion of severe vision impairment attributable to cataract increased from 19.0% to 28.9%, while the cause composition of blindness showed no significant change.[26] These patterns, coupled with the rising burdens of diabetic retinopathy and age-related diseases, reflect shifting demographics.[26] These mixed results show that while national health strategies have expanded services, the impact of investments varies widely depending on the epidemiology and demography of each country.

It should be noted that strong performance in eye health indicators is not confined to countries with dedicated national eye health plans. Evidence has demonstrated that high effective refractive error coverage (eREC) and eCSC, the WHO-endorsed benchmarks for coverage and quality of care targeted for improvement by 2030, are highest in high-income countries, where eye care is embedded within well-resourced health systems, characterized by robust primary care and stable financing.[23, 35] Notably, some of these countries, such as the United States, lack a specific national strategic plan for eye health according to the IAPB data,[36] suggesting that health system architecture and resource availability serve as stepping stones for favorable outcomes.

While national planning and programmatic investment have advanced eye care in many settings, substantial inequities persist, particularly among women, the elderly, and children, underscoring that these populations require more targeted attention.[37] Women not only experience a higher prevalence and burden of vision loss but also receive lower-quality eye care services and demonstrate a lower uptake of those services when undergoing surgical procedures, targeted local delivery can substantially reduce these gender gaps.[10,35,38-44]. These inequalities have been attributed to economic barriers, limited mobility, lower health literacy, and longer female life expectancy, emphasizing the need for routine equity-focused monitoring in national and global eye health planning.[45-47]

Older adults also need special attention: evidence across multiple studies indicates that vision loss in the elderly is associated with social isolation, reduced mobility, higher fall risk, and greater mortality, disproportionately affecting those in lower-income settings.[4,43] These inequities are expected to widen as populations aged over 60 years are projected to double by 2050, making targeted, age-responsive eye-care strategies essential to prevent a growing burden in rapidly ageing societies.[48]

The third population in need of attention is children and young adults, particularly given that research on young adults remains more limited than that on other age groups. The myopia epidemic in children, which is gaining further attention as a substantial issue, needs to be addressed.[49] Given the scale of the pediatric myopia epidemic, particularly in East Asia, this issue should be viewed as an impending public health crisis. National accountability frameworks should mandate routine, standardized school-based visual acuity and biometric screening, including refractive error and axial length where feasible, to capture disease burden early. Without such surveillance, countries cannot reliably assess outdoor-time policies, myopia-control interventions, referral pathways, or the early-life trends. Moreover, specific high-burden events due to vision impairment, such as injuries from road traffic accidents in 15–25-year-olds, merit further focus.[50-52] Additionally, vision status in youth may influence life trajectories,[53] including education and employment opportunities,[54-58] another factor highlighting the importance of prioritizing adolescent and young-adult eye health within national monitoring frameworks.

Besides identifying vulnerable populations, it is equally important to recognize the specific co-morbid conditions with the potential for cross-sector action and coordinated care that remain insufficiently addressed within eye health policy and service delivery. Evidence shows a strong bidirectional link between vision loss and mental health;[59-60] 25% of people with eye disease experience clinically significant depressive symptoms.[61-63] Vision loss has also consistently been associated with cognitive decline and higher dementia risk across multiple longitudinal studies,[64-68] a relationship now being further explored in randomized trials.[58] Beyond mental health, dual-sensory impairment remains under-addressed despite its high prevalence and the ease and low cost of screening.[69] These interdependencies make eye health an effective entry point for integrated screening models, linking vision care with hearing assessment, mental health conditions, and broader health access in underserved populations.[70]

As the scope of eye health priorities expands, understanding the economic implications of addressing these needs becomes increasingly important.[71-72] The largest recent economic modelling exercise suggests that eye care delivery is among the highest-yield health investments, estimating that each $1 invested in LMIC settings could generate $28 in productivity gains.[73-74] A targeted $7.1 billion package during 2026-2030 covering basic examinations, refractive services, and cataract surgery could unlock $199 billion in productivity within five years, with potential global returns rising to $447 billion annually if all preventable vision loss were addressed.[74]

Despite extensive estimates of economic returns and comprehensive national and international plans, there is no standardized way to link increases in financial investment, infrastructure, or workforce expansion to expected reductions in the burden of blindness and vision impairment. This gap remains one of the most significant weaknesses in global eye health accountability, and addressing it will require analytical systems capable of linking policy actions to changes in burden over time. As noted, a persistent barrier to effective eye health governance is the absence of clear, measurable targets within many national plans.

As highlighted in the GBD's 30-year review, the system now integrates over 150,000 data sources, including surveys, censuses, administrative health data, and clinical databases, and recomputes full historical time series with each release to maintain strict comparability across time and space.[7] Its statistical architecture, Disease Modelling Meta-Regression (DisMod-MR) 2.1, cross-walking methods, and uncertainty quantification were specifically designed to handle sparse or conflicting data, harmonize heterogeneous case definitions, and generate best estimates even where national data are limited. As GBD expands subnational estimation, strengthens integration with routine data, and develops forecasting tools, it offers an unparalleled, consistent outcome backbone for benchmarking trends. However, given GBD estimates' reliance on multi-layered modelling and attribution assumptions, they are not optimized for drawing causal inferences about the impact of specific investments or programs at national or subnational levels; such inference requires purpose-built designs that measure exposure to interventions and track outcomes over time.

In its current state, additional constraints also exist. In one study evaluating eREC, it was noted that nationally-representative data at two time points were available for only six countries.[35] In the landmark GBD study on the burden of vision loss, fewer than one in five data sources were nationally representative (only 18% of RAAB studies and 18% of non-RAAB population surveys), highlighting how sparse truly nationwide data remain.[10] This could be extended to other data sources used for GBD estimates, pointing to room for improvement in terms of representativeness. In fact, using GBD to map investments in a country to resulting declines in vision impairment does not provide sufficient granularity for such a goal. Adjustments for socioeconomic factors, healthcare access, or demographic structure may help mitigate bias, but cannot fully compensate for gaps in primary data collection. This underscores why GBD estimates must be analyzed and interpreted in the context of prior knowledge of the data structure, particularly in settings where data are derived from a small number of subnational surveys. Triangulating GBD outputs with national statistical reports, specialized clinical datasets, and independent academic studies remains essential for context-specific interpretation, a task conducted by the official collaborator-led GBD studies. Ultimately, these limitations reinforce, rather than weaken, the value of GBD: the need for a unified, transparent, and evolving global framework capable of integrating heterogeneous sources, standardizing definitions, and establishing comparable indicators across settings. However, they also emphasize that improvements in data representativeness and surveillance infrastructure are essential if the GBD is to serve as a more precise tool for assessing policy impact and guiding future eye health planning.

Given these limitations, efforts to quantify how investments translate into measurable reductions in vision-loss burden will require data sources with suitable temporal and geographic resolution. At present, the most reliable approach is to rely on repeated nationally representative population-based surveys, such as RAABs, although the studies conducted in the same districts or provinces at multiple time points, especially in countries that have implemented sustained national eye health strategies, such as Nepal, are sparse. However, RAAB studies could be modified to allow for more robust causal claims about the relationship between investment and visual impairment. More frequent surveys, repeated sampling of the same districts, rollout-aware designs aligned with program implementation, and the inclusion of modules capturing service utilization, socio-economic outcomes, and key covariates would allow RAAB data to support quasi-experimental analyses of investment impact. Together, these refinements would preserve the feasibility of RAAB while making it substantially more informative for linking investment and service delivery to changes in population vision outcomes. Until more countries generate high-quality nationwide data, such studies remain a practical, though not exhaustive, foundation for assessing investment impact and building more precise models of how funding, workforce growth, or service delivery improvements translate into reductions in the burden of vision loss.

Looking ahead, the evolution of vision loss surveillance will need to extend beyond traditional population-based surveys and move toward integrating digital health infrastructure and AI-enabled systems. While RAAB and similar surveys remain valuable, they are inherently limited in providing continuous, nationally representative, or real-time estimates of vision loss. Digital health and AI-based surveillance may offer an important complementary pathway to address persistent evidence gaps in these key limitations of population-based surveys and global eye health.[75] The increasing availability of electronic medical records, telemedicine platforms, school screening programs, and AI-enabled screening systems creates new opportunities to monitor eye disease burden at scale. In LMICs, survey data are often sparse, outdated, or limited to selected regions. AI-enabled screening networks could provide a scalable mechanism for identifying unmet need and monitoring service coverage, thereby improving the timeliness and spatial resolution of estimates from conventional surveillance tools, provided they are rigorously validated against population-based data and adjusted for selection bias, access barriers, and differences in diagnostic standards. At the same time, careful attention is needed to ensure data quality, representativeness, interoperability, privacy, and the mitigation of algorithmic bias. Integrating digital surveillance with traditional epidemiology may therefore represent the next step toward a more responsive and equitable vision loss burden estimation.

Correction notice

None

Acknowledgements

None

Author Contributions

(I) Conception and design: N.C, H.F
(II) Administrative support: N.C, B.W
(III) Provision of study materials or patients: H.F
(IV) Collection and assembly of data: N.C, H.F, B.W
(V) Data analysis and interpretation: N.C, H.F, B.W
(VI) Manuscript writing: All authors
(VII) Final approval of manuscript: All authors

Funding

None

Conflict of Interests

None of the authors has any conflicts of interest to disclose. All authors have declared in the completed ICMJE uniform disclosure form.

Patient consent for publication

None

Ethics approval and consent to participate

None

Data availability statement

None

References

1. World Health Organization. Universal eye health: a global action plan 2014–2019. 2013. Available from: https://

www.who.int/publications/i/item/universal-eye-health-a-global-action-plan-2014-2019.

2. Pawar S. 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. SSRN Journal, 2021. DOI: 10.2139/ssrn.3939242.
3. World Health Organization. World report on vision. 2019. Available from: https://www.who.int/publications/i/item/9789241516570.
4. Burton MJ, Ramke J, Marques AP, et al. The Lancet Global Health commission on global eye health: vision beyond 2020. Lancet Glob Health. 2021, 9(4): e489-e551. DOI: 10.1016/S2214-109X(20)30488-5.
5. United Nations General Assembly. Vision for everyone: accelerating action to achieve the sustainable development goals. 2021. Report No.: A/RES/75/310. Available from: https://documents.un.org/doc/undoc/gen/n21/204/98/pdf/n2120498.pdf OpenElement.
6. Stern J, Yasmin S, Qureshi MB, et al. 2030 in Sight: the future of global eye health. Eye. 2024, 38(11): 1979-1980. DOI: 10.1038/s41433-023-02815-2.
7. Murray CJL. The global burden of disease study at 30 years. Nat Med. 2022, 28(10): 2019-2026. DOI: 10.1038/s41591-022-01990-1.
8. Murray CJL, Abbafati C, Abbas KM, et al. Five insights from the global burden of disease study 2019. Lancet. 2020, 396(10258): 1135-1159. DOI: 10.1016/s0140-6736(20)31404-5.
9. GBD 2023 Disease and Injury and Risk Factor Collaborators. Burden of 375 diseases and injuries, risk-attributable burden of 88 risk factors, and healthy life expectancy in 204 countries and territories, including 660 subnational locations, 1990-2023: a systematic analysis for the Global Burden of Disease Study 2023. Lancet. 2025, 406(10513): 1873-1922. DOI: 10.1016/S0140-6736(25)01637-X.
10. Bourne R, Steinmetz JD, Flaxman S, et al. 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. DOI: 10.1016/S2214-109X(20)30425-3.
11. Flaxman SR, Bourne RRA, Resnikoff S, et al. Global causes of blindness and distance vision impairment 1990-2020: a systematic review and meta-analysis. Lancet Glob Health. 2017, 5(12): e1221-e34. DOI: 10.1016/s2214-109x(17)30393-5.
12. Bourne RRA, Flaxman SR, Braithwaite T, et al. Magnitude, temporal trends, and projections of the global prevalence of blindness and distance and near vision impairment: a systematic review and meta-analysis. Lancet Glob Health. 2017, 5(9): e888-e897. DOI: 10.1016/S2214-109X(17)30293-0.
13. Vision Loss Expert Group of the Global Burden of Disease Study, GBD 2019 Blindness and Vision Impairment Collaborators. Global estimates on the number of people blind or visually impaired by glaucoma: A meta-analysis from 2000 to 2020. Eye (Lond). 2024, 38(11): 2036-2046. DOI: 10.1038/s41433-024-02995-5.
14. Pesudovs K, Lansingh VC, Kempen JH, et al. Global estimates on the number of people blind or visually impaired by cataract: a meta-analysis from 2000 to 2020. Eye. 2024, 38(11): 2156-2172. DOI: 10.1038/s41433-024-02961-1.
15. FVision Loss Expert Group of the Global Burden of Disease Study; GBD 2019 Blindness and Vision Impairment Collaborators. Global estimates on the number of people blind or visually impaired by age-related macular degeneration: a meta-analysis from 2000 to 2020. Eye. 2024, 38(11): 2070-2082. DOI: 10.1038/s41433-024-03050-z.
16. Little JA, Congdon NG, Resnikoff S, et al. Global estimates on the number of people blind or visually impaired by Uncorrected Refractive Error: a meta-analysis from 2000 to 2020. Eye. 2024, 38(11): 2083-2101. DOI: 10.1038/s41433-024-03106-0.
17. Bourne RRA, Stevens GA, White RA, et al. Causes of vision loss worldwide, 1990–2010: a systematic analysis. Lancet Glob Health. 2013, 1(6): e339-e349. DOI: 10.1016/s2214-109x(13)70113-x.
18. Ramke J, Zwi AB, Silva JC, et al. Evidence for national universal eye health plans. Bull World Health Organ. 2018, 96(10): 695-704. DOI: 10.2471/blt.18.213686.
19. MacTaggart I, Limburg H, Bastawrous A, et al. Rapid Assessment of Avoidable Blindness: looking back, looking forward. Br J Ophthalmol. 2019, 103(11): 1549-1552. DOI: 10.1136/bjophthalmol-2019-314015.
20. World Health Organization. Report of the 2030 targets on effective coverage of eye care. 2022. Available from: https://www.who.int/publications/i/item/9789240058002.

21. Khan AA, Khan NU, Bile KM, et al. Creating synergies for health systems strengthening through partnerships in Pakistan - a case study of the national eye health programme. East Mediterr Health J. 2010, 16: 61-68. DOI: 10.26719/2010.16.supp.61.
22. Hassan B, Ahmed R, Li B, et al. A comprehensive study capturing vision loss burden in Pakistan (1990-2025): Findings from the Global Burden of Disease (GBD) 2017 study. PLoS One. 2019, 14(5): e0216492. DOI: 10.1371/journal.pone.0216492.
23. McCormick I, Butcher R, Evans JR, et al. Effective cataract surgical coverage in adults aged 50 years and older: estimates from population-based surveys in 55 countries. Lancet Glob Health. 2022, 10(12): e1744-e1753. DOI: 10.1016/s2214-109x(22)00419-3.
24. Gurung R, Oli RU. Primary eye care in Nepal: current situation and recommendations for integration. Community Eye Health. 2021, 34(113): s13-s4.
25. He MG, Wang W, Zhao JL. Prevention of blindness and ophthalmic epidemiology in China over the past 70 years. Zhonghua Yan Ke Za Zhi. 2020, 56(8): 561-566. DOI: 10.3760/cma.j.cn112142-20200602-00366.
26. Xu T, Wang B, Liu H, et al. Prevalence and causes of vision loss in China from 1990 to 2019: findings from the Global Burden of Disease Study 2019. Lancet Public Health. 2020, 5(12): e682-e691. DOI: 10.1016/S2468-2667(20)30254-1.
27. Wang N, Deng S, Tian L. A review of trachoma history in China: research, prevention, and control. Sci China Life Sci. 2016, 59(6): 541-547. DOI: 10.1007/s11427-016-5056-z.
28. Wu X, Shi X, Li H, et al. Temporal and spatial characteristics of cataract surgery rates in China. Risk Manag Healthc Policy. 2021, 14: 3551-3561. DOI: 10.2147/RMHP.S317547.
29. Shu Y, Shao Y, Zhou Q, et al. Changing trends in the disease burden of cataract and forecasted trends in China and globally from 1990 to 2030. Clin Epidemiol. 2023, 15: 525-534. DOI: 10.2147/clep.s404049.
30. AIER Eye Hospital Group. Bringing together global cutting-edge perspectives to shape the future of refractive cataract surgery [in Chinese] 2023 [Available from: https://www.aierchina.com/jituanxinwen/5.html.
31. Du YF, Liu HR, Zhang Y, et al. Prevalence of cataract and cataract surgery in urban and rural Chinese populations over 50 years old: a systematic review and Meta-analysis. Int J Ophthalmol. 2022, 15(1): 141-149. DOI: 10.18240/ijo.2022.01.21.
32. Yan X, Congdon N, He M. Prevention of cataract blindness in rural China. Asia Pac J Ophthalmol. 2012, 1(2): 69-71. DOI: 10.1097/APO.0b013e31824a4383.
33. Zhang M, Wu X, Li L, et al. Understanding barriers to cataract surgery among older persons in rural China through focus groups. Ophthalmic Epidemiol. 2011, 18(4): 179-186. DOI: 10.3109/09286586.2011.580884.
34. Zhang XJ, Liang YB, Liu YP, et al. Implementation of a free cataract surgery program in rural China a community-based randomized interventional study. Ophthalmology. 2013, 120(2): 260-265. DOI: 10.1016/j.ophtha.2012.07.087.
35. Bourne RRA, Cicinelli MV, Selby DA, et al. Effective refractive error coverage in adults: a systematic review and meta-analysis of updated estimates from population-based surveys in 76 countries modelling the path towards the 2030 global target. Lancet Glob Health. 2025, 13(8): e1396-e405. DOI: 10.1016/s2214-109x(25)00194-9.
36. International Agency for the Prevention of Blindness. Vision Atlas: Country Data: International Agency for the Prevention of Blindness; Available from: https://visionatlas.iapb.org/country-data/.
37. Hosseinpoor AR, Bergen N, Koller T, et al. Equity-oriented monitoring in the context of universal health coverage. PLoS Med. 2014, 11(9): e1001727. DOI: 10.1371/journal.pmed.1001727.
38. Abou-Gareeb I, Lewallen S, Bassett K, et al. Gender and blindness: a meta-analysis of population-based prevalence surveys. Ophthalmic Epidemiol. 2001, 8(1): 39-56. DOI: 10.1076/opep.8.1.39.1540.
39. Hashemi H, Mohammadi SF, Z-Mehrjardi H, et al. The role of demographic characteristics in the outcomes of cataract surgery and gender roles in the uptake of postoperative eye care: a hospital-based study. Ophthalmic Epidemiol. 2012, 19(4): 242-248. DOI: 10.3109/09286586.2012.691600.
40. Baruwa E, Tzu J, Congdon N, et al. Reversal in gender valuations of cataract surgery after the implementation of free screening and low-priced high-quality surgery in a rural population of Southern China. Ophthalmic Epidemiol. 2008, 15(2): 99-104. DOI: 10.1080/09286580801999118.

41. Congdon N, Fan H, Choi K, et al. Impact of posterior subcapsular opacification on vision and visual function among subjects undergoing cataract surgery in rural China: Study of Cataract Outcomes and Up-Take of Services (SCOUTS) in the Caring is Hip Project, Report 5. Br J Ophthalmol. 2008, 92(5): 598-603. DOI: 10.1136/bjo.2007.126714.
42. Mavi S, Whitestone N, Chan VF, et al. Global gender disparities in access to refractive error services a systematic review and meta-analysis. Ophthalmology. 2026, 133(2): 257-277. DOI: 10.1016/j.ophtha.2025.08.031.
43. Ehrlich JR, Stagg BC, Andrews C, et al. Vision impairment and receipt of eye care among older adults in low- and middle-income countries. JAMA Ophthalmol. 2019, 137(2): 146. DOI: 10.1001/jamaophthalmol.2018.5449.
44. Cardona M, Alwenya K, Rehman AU, et al. Eye care interventions that reduce access inequities for women, rural residents and older people in low-middle-income countries: a scoping review. Front Public Health. 2025, 13: 1578848. DOI: 10.3389/fpubh.2025.1578848.
45. Rius Ulldemolins A, Benach J, Guisasola L, et al. Why are there gender inequalities in visual impairment. Eur J Public Health. 2019, 29(4): 661-666. DOI: 10.1093/eurpub/cky245.
46. Rius A, Artazcoz L, Guisasola L, et al. Visual impairment and blindness in Spanish adults geographic inequalities are not explained by age or education. Ophthalmology. 2014, 121(1): 408-416. DOI: 10.1016/j.ophtha.2013.07.017.
47. Ramke J, Zwi AB, Palagyi A, et al. Equity and blindness: closing evidence gaps to support universal eye health. Ophthalmic Epidemiol. 2015, 22(5): 297-307. DOI: 10.3109/09286586.2015.1077977.
48. Swenor BK, Ehrlich JR. Ageing and vision loss: looking to the future. Lancet Glob Health. 2021, 9(4): e385-e386. DOI: 10.1016/S2214-109X(21)00031-0.
49. Holden BA, Fricke TR, Wilson DA, et al. Global prevalence of myopia and high myopia and temporal trends from 2000 through 2050. Ophthalmology. 2016, 123(5): 1036-1042. DOI: 10.1016/j.ophtha.2016.01.006.
50. Ahmed M, Patnaik JL, Whitestone N, et al. Visual impairment and risk of self-reported road traffic crashes among bus drivers in Bangladesh. Asia Pac J Ophthalmol. 2022, 11(1): 72-78. DOI: 10.1097/APO.0000000000000471.
51. Piyasena P, Olvera-Herrera VO, Chan VF, 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-e1422. DOI: 10.1016/S2214-109X(21)00303-X.
52. Le VC, To KG, Le VD, et al. STABLE trial of spectacle provision and driving safety among myopic motorcycle users in Vietnam: study protocol for a stepped-wedge, cluster randomised trial. Trials. 2024, 25(1): 825. DOI: 10.1186/s13063-024-08644-2.
53. Du K, Patil P, Boland MV. Mental health of US children with vision impairment: an analysis of the national health interview survey. Am J Ophthalmol. 2025, 277: 451-462. DOI: 10.1016/j.ajo.2025.06.002.
54. Ma X, Zhou Z, Yi H, et al. Effect of providing free glasses on children's educational outcomes in China: cluster randomized controlled trial. Bmj. 2014, 349(sep23 7): g5740. DOI: 10.1136/bmj.g5740.
55. Ma Y, Congdon N, Shi Y, et al. Effect of a local vision care center on eyeglasses use and school performance in rural China: a cluster randomized clinical trial. JAMA Ophthalmol. 2018, 136(7): 731. DOI: 10.1001/jamaophthalmol.2018.1329.
56. Sehrin F, Jin L, Naher K, et al. 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. 2024, 19(4): e0296115. DOI: 10.1371/journal.pone.0296115.
57. Parami Dhakhwa B E, Brad Wong. Better education in sight. An estimate of global learning and economic productivity losses from uncorrected refractive error in schools. 2024. Available from: https://www.iapb.org/wp-content/uploads/2024/10/VA_Better_Education_in_sight_Tech_Report.pdf.
58. Marmamula S, Alladi S, Umapathy K, et al. Cognitive Level Enhancement through Vision Exams and Refraction (CLEVER): study protocol for a randomised controlled trial. Trials. 2025, 26(1): 109. DOI: 10.1186/s13063-025-08813-x.
59. Demmin DL, Silverstein SM. Visual impairment and mental health: unmet needs and treatment options. Clin Ophthalmol. 2020, 14: 4229-4251. DOI: 10.2147/OPTH.

S258783.

60. Li D, Chan VF, Virgili G, et al. Impact of vision impairment and ocular morbidity and their treatment on depression and anxiety in children a systematic review. Ophthalmology. 2022, 129(10): 1152-1170. DOI: 10.1016/j.ophtha.2022.05.020.
61. Parravano M, Petri D, Maurutto E, et al. Association between visual impairment and depression in patients attending eye clinics: a meta-analysis. JAMA Ophthalmol. 2021, 139(7): 753. DOI: 10.1001/jamaophthalmol.2021.1557.
62. Virgili G, Parravano M, Petri D, et al. The association between vision impairment and depression: a systematic review of population-based studies. J Clin Med. 2022, 11(9): 2412. DOI: 10.3390/jcm11092412.
63. Zheng Y, Wu X, Lin X, et al. The prevalence of depression and depressive symptoms among eye disease patients: a systematic review and meta-analysis. Sci Rep. 2017, 7: 46453. DOI: 10.1038/srep46453.
64. Ferguson EL, Thoma M, Buto PT, et al. Visual impairment, eye conditions, and diagnoses of neurodegeneration and dementia. JAMA Netw Open. 2024, 7(7): e2424539. DOI: 10.1001/jamanetworkopen.2024.24539.
65. Rahmati M, Smith L, Lee H, et al. Associations between vision impairment and eye diseases with dementia, dementia subtypes and cognitive impairment: an umbrella review. Ageing Res Rev. 2024, 101: 102523. DOI: 10.1016/j.arr.2024.102523.
66. Smith JR, Huang AR, Zhou Y, et al. Vision impairment and the population attributable fraction of dementia in older adults. JAMA Ophthalmol. 2024, 142(10): 900. DOI: 10.1001/jamaophthalmol.2024.3131.
67. Lee GI, Chi SA, Kim K, et al. Visual impairment increases the risk of dementia, especially in young males in a 12-year longitudinal follow-up study of a national cohort. Sci Rep. 2021, 11: 11393. DOI: 10.1038/s41598-021-91026-4.
68. Shang X, Zhu Z, Wang W, et al. The association between vision impairment and incidence of dementia and cognitive impairment a systematic review and meta-analysis. Ophthalmology. 2021, 128(8): 1135-1149. DOI: 10.1016/j.ophtha.2020.12.029.
69. Haile LM, Kamenov K, Briant PS, et al. Hearing loss prevalence and years lived with disability, 1990–2019: findings from the Global Burden of Disease Study 2019. Lancet. 2021, 397(10278): 996-1009. DOI: 10.1016/S0140-6736(21)00516-X.
70. Kha R, Macken O, Mitchell P, et al. The Australian Eye and Ear Health Survey (AEEHS): Study protocol for a population-based cross-sectional study. PLoS One. 2024, 19(5): e0301846. DOI: 10.1371/journal.pone.0301846.
71. Marques AP, Ramke J, Cairns J, et al. Global economic productivity losses from vision impairment and blindness. EClinicalMedicine. 2021, 35: 100852. DOI: 10.1016/j.eclinm.2021.100852.
72. Rein DB, Wittenborn JS, Zhang P, et al. The economic burden of vision loss and blindness in the United States. Ophthalmology. 2022, 129(4): 369-378. DOI: 10.1016/j.ophtha.2021.09.010.
73. Wong B, Singh K, Everett B, et al. The case for investment in eye health: systematic review and economic modelling analysis. Bull World Health Organ. 2023, 101(12): 786-799. DOI: 10.2471/blt.23.289863.
74. Wong B H J, Stern J, et al. The value of vision: the case for investing in eye health. 2025. Available from: https://visionatlas.iapb.org/global-investment-case/.
75. Tan TF, Thirunavukarasu AJ, Jin L, et al. Artificial intelligence and digital health in global eye health: opportunities and challenges. Lancet Glob Health. 2023, 11(9): e1432-e1443. DOI: 10.1016/S2214-109X(23)00323-6.