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Contents lists available at Lighthouse Scholar

EYE SCIENCE

journal homepage: journal.gzzoc. com

doi: 10.12419/es2025021401
View this article at: https://dx.doi.org/10.12419/es2025021401

· Perspective ·

Vision care and the sustainable development goals: a brief review and suggested research agenda

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Cite this article as: Congdon N, Wong B, Guo X, MacKenzie G. Vision care and the sustainable development goals: a brief review and suggested research agenda. Eye Science, 2025, 2(2): 103-110. doi: 10.12419/es20250601.

Blindness affected 45 million people globally in 2021, and moderate to severe vision loss a further 295 million.[1] The most common causes, cataract and uncorrected refractive error, are generally the easiest to treat, and are among the most cost-effective procedures in all of medicine and international development.[1-2] Thus, vision impairment is both extremely common and, in principle, readily manageable.

Despite this, very few healthcare systems, whether in poor or wealthy countries, invest fully in vision care. In developing countries, high-quality eye health services at affordable prices are often inaccessible, particularly in rural and other underserved settings. Even in developed countries, important vision services such as refraction and provision of glasses often involve substantial co-pays, placing them out of the reach of many citizens. Access to eye care is further influenced by social determinants of health with significant inequities in resource allocation and care delivery observed across different regions and socio-economic strata.[3]

Received date: 2025-02-14; **Revised date:** 2025-06-12; **Accepted date:** 2025-06-20; **Published online:** 2025-06-27
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Full Text

Recent comprehensive statements about vision care, such as the Lancet global Eye Health Commission report,[1] and the 2021 United Nations general assembly's "vision for everyone" resolution,[4] have called for better integration of eye care services into national healthcare systems. While this is an important and desirable outcome, what has been lacking from these calls is a clear rationale: what concrete benefits does vision care offer to societies, sufficient to prompt healthcare system planners to invest? The fact is that recent research offers robust answers to this important question, and that a growing body of evidence reveals important and specific ways in which vision care can accelerate progress towards the Sustainable Development Goals (SDGs) across the life course.[1,5–9] This brief review will marshal existing evidence, and also highlight important gaps that can readily be addressed with strategically-designed studies. There is a crucial need for the vision research community to prioritize the delivery of high-quality evidence, particularly in the form of randomized controlled trials (RCTs), demonstrating causal links between the delivery of affordable vision care and desirable development outcomes, particularly those stressed in the SDGs, among both children and adults. The current review will follow the order of the SDGs themselves,[10] and within each, will separately discuss results for adults and, where relevant, children.

The first SDG, the alleviation of poverty, is the basis upon which all development depends: health, equity, safe cities, meaningful work and good education, all of these depend on the successful alleviation of poverty. High quality trial evidence supports the hypothesis that vision care is among the most effective health interventions to promote productivity and increase earnings. The first trial in this area, PROSPER,[7] was published in 2018, and demonstrated that provision of near glasses to presbyopic tea pickers in Assam India led to a 21.7% increase in productivity over the course of a three-month period, an additional five kilograms of tea picked per day. An even greater increase, in excess of 30%, was observed among workers aged 50 years and above, providing further biological plausibility to the trial results. Additional important findings included high rates of adherence with the glasses intervention, reaching 85% by the end of the trial, and the willingness among some 95% of participants to purchase spectacles at their own cost if theirs were to be lost or broken. The observed effect size was greater than had been seen for any previous health trial in the workplace.

The findings of the PROSPER trial have since been confirmed by the 2023 THRIVE trial in Bangladesh.[8] THRIVE, which extended the results of PROSPER to artisans, shopkeepers and a variety of other visually intensive job types, revealed a 30% increase in self-reported income over six months. Notably, the trial also demonstrated the ability of community health workers to deliver a successful glasses intervention after only a few hours of training. The recent PROSPER 2 trial has further extended these results to garment factory workers: the statistically significant 6% productivity benefit conferred by a pair of glasses was equal to roughly 2/3 of the difference between the most and least skilled workers in the factory. Finally, the SUCCESS trial[11] in China has further shown that delivery of free cataract surgery increases self-reported income by nearly 60%. Although income in this trial was estimated through self-reported activities, and was thus susceptible to placebo effects, the important finding of a strong association between an increase in income and improvement in postoperative visual acuity provides strong biological plausibility for the results of this trial.

In summary, four published trials on the workplace productivity and earning benefits of vision care have been consistent, providing a body of evidence that extends from agriculture (PROSPER)[7] to craft work (THRIVE)[8] to manufacturing (PROSPER II) to labour in the home (SUCCESS).[11] Nonetheless, important gaps remain in the literature on vision interventions and livelihood. In the first place, the only RCTs to assess the impact on the earnings of beneficiaries, as opposed to productivity benefits, were the THRIVE and SUCCESS studies. Income in both was self-reported, which is inherently susceptible to placebo effects. In many workplace settings, including agricultural plantations and many factories, bonus incentives for better productivity can translate directly into increased earnings. However, different payment structures are used in various settings, and the specific effects of vision care on income require further research. While there are substantial societal benefits to enhanced worker productivity,[12] the case

for vision care as a poverty alleviation strategy can be greatly strengthened with further trials using earnings or consumption as outcomes.

Additionally, factories and agricultural plantations offer substantial benefits in terms of efficient delivery of vision interventions, and are thus inherently appealing to programme planners. However, many types of work do not include such close geographic concentration of labourers. An important example is that of farmers, especially those raising food crops. Fully one third of the world's food is grown by smallholder farmers,[13-14] who are under unique pressures from climate change and other factors. Their small-scale operations make it difficult to invest in climate resilience strategies, such as using mechanized tools and better water management. Improved earnings and enhanced productivity from delivery of glasses could bring these modest investments within reach, potentially creating a positive cycle of improved climate resilience. Despite the inherent difficulties in enrolment and assessment of outcomes for RCTs among more geographically dispersed farmers, the potential benefits of trial-proven, affordable visions strategies to enhance climate resilience, productivity and income among small holder farmers are substantial, and warrant further research.

Online banking is an increasingly important tool to increase financial inclusiveness. Recent reviews suggest that impaired vision, particularly presbyopia, is associated with difficulties in mobile phone use,[15-16] an important tool for access to online banking. There are at present no published trials assessing the potentials benefits to financial inclusiveness from provision of spectacles to enhance use of mobile phones and online banking in low-resource settings. The ongoing THRIFT trial[17] in Bangladesh, where all social safety net payments to the elderly are made online, is designed to assess the impact of spectacle provision on online banking behaviour among Old Age and Widows Allowance beneficiaries.

Finally, as successful as low-cost vision interventions have proven in enhancing productivity across a variety of workplaces, it seems unlikely that no other cost-effective health treatments could confer similar benefits. Further research is needed to create and assess the effectiveness of evidence-driven baskets of low-cost health interventions, that could be combined with eye care, to maximize productivity benefits. Such health interventions would need to be inexpensive, simple enough to be delivered by community health workers, and readily scalable. Given the strong evidence for the importance of musculoskeletal pain due to repetitive activities in agricultural[18] and manufacturing jobs,[19] scalable and cost-effective interventions to combat this are an important area for future research.

SDG 3 focuses on health and well-being. Longitudinal studies suggest that cataract surgery can reduce all-cause mortality,[20-21] though this has never been assessed in RCTs due to both ethical challenges and the difficulty of ensuring sufficient follow-up and statistical power. Similarly, cataract surgery has been shown to improve depressive symptoms and cognitive function,[22] although the results were limited by a lack of robust RCTs.

Mental health has received increasing attention as a crucial element of overall well-being in recent years.[23] Evidence of a strong association between good vision and improvement in health is available for both children and adults. Two recent systematic reviews[24-25] have assessed the association between poor vision/eye disease and mental health disorders, including depression and anxiety, among children. The meta-analysis carried out in the first of these papers revealed a strong association between poor vision, and also unoperated strabismus, and excess burdens of depression and anxiety.[24] The second paper found a similar association between poor quality of life and vision problems among children.[25] The association was particularly strong in both reviews for uncorrected refractive error. As refractive error is one of the most readily corrected vision problems among children, this underscores the opportunity to improve children's mental health through low-cost vision strategies. Among older adults, a number of longitudinal studies have strongly suggested that more rapid declines in vision are associated with worsening cognitive status.[26-27] Furthermore, many individuals with vision impairment rely on informal caregiving, and depression rates among caregivers range from 4%-48%.[28]

Important gaps however remain in the literature on the association between vision and mental health among both children and adults. Further trials are needed among children to demonstrate that interventions such as

provision of glasses and strabismus surgery can reduce existing excess burdens of depression and anxiety. Among adults, there is a current complete lack of RCTs assessing the question of whether provision of near and distance glasses can slow the pace of cognitive decline with ageing. The ongoing CLEVER[29] trial in India is designed to address the question. If glasses can indeed reduce the risk of dementia, this would be a highly significant finding for healthcare systems, particularly in low-resource settings, where ageing populations and the rising economic burden of dementia care pose major challenges. The global cost of dementia care is expected to exceed US$2 trillion by 2030,[30] with per capita costs in Low and Middle Income Countries (LMICs) ranging from US$590 for mild cases to US$25,500 for severe cases.[31] In India alone, dementia-related costs are projected to reach 0.5% of GDP by 2050.[32-33] Despite this growing financial strain, proven, low-cost strategies to slow cognitive decline remain scarce, making cost-effective interventions like glasses particularly valuable. Lastly, there is no trial evidence demonstrating the impact of vision correction on caregivers of the visually impaired, a historically under-researched population.

SDG 4 addresses the need for equitable access to quality education. Several RCTs have now been published, principally from China and the United States, consistently demonstrating that delivery of spectacles to children at no out-of-pocket cost with uncorrected refractive error improves academic outcomes.[34] The first of these demonstrated that the effect size from spectacle provision could approach a semester or more of increased learning, exceeding the impact of family income, parental education and other health care interventions delivered in schools. Subsequent additional trials in China[35-36] and the US[37–39] have provided consistent results. These findings, together with the relatively low cost of vision screening and spectacle delivery in the school setting, have led to increasing adoption of such programmes in Asia, Africa and elsewhere.

Despite the consistency of these research results, and their success in promoting investment in programmes, important research gaps remain. In the first place, existing evidence of benefit from school-based delivery of spectacles is limited to China and the United States. There is a need for additional trials in sub-Saharan Africa and in India, the country with more children than any other on earth. Given the profound differences in epidemiology and school systems between these regions, pertinent local evidence is needed to drive local policy change. Further, academic improvement from glasses provision is not always sustained after follow-up, and understanding why this happens is a key research gap. One hypothesis that warrants further investigation is the lack of long-term adherence to glasses wear. Additionally, as with multifaceted health interventions for productivity outcomes, there is huge potential to combine vision correction with low cost, effective pedagogical strategies to address the global learning crisis. Lastly, as important as enhanced academic performance may be, there is also a need to assess other profoundly life-changing school outcomes, such as school attainment and future employment. The ongoing SWISH trial in China is designed to assess the hypothesis that provision of free glasses at the beginning of the three-year middle school period can increase rates of subsequent high school attendance, currently about 50%.

SDG 5 and 10 are both concerned with decreasing inequity. SDG 5 relates specifically to gender inequality, while SDG 10 targets reductions in inequality more broadly, including those related to age, racial status, and socioeconomic factors. Evidence from systematic reviews[40-41] consistently shows that women and girls bear an unfair burden of vision impairment, due both to biological reasons, such as the longer life span enjoyed by women, but also resulting from unequal access to health care and other important services. Due to the increasing access of girls to schools throughout Asia and Africa, school-based vision screening programmes provide an important opportunity to redress unequal access of female students to refraction and other vision services. Additionally, workplace-based vision screening and glasses provision are proven to improve productivity and earnings in female dominated areas such as tea-picking and the garment sector.[7] Gaps in the existing literature include the need for further evidence assessing the long-term educational benefits of glasses provision to girls and other marginalized groups in school settings, and also studies exploring potential knock-on benefits from women's additional earnings to their children and other family members.

SDG 11 focuses on safe cities, a crucial aspect of which is safe transportation. The leading cause of death globally between the ages of 5 and 29 years is traffic crashes, the burden of which is born unfairly, nearly 90%, by LMICs, though only 60% of cars are driven in such settings.[10, 42] Studies and reviews of research carried out in high-income countries have consistently failed to demonstrate a strong association between Central vision and traffic crash outcomes.[43–45] However, Piyasena et al.'s[6] recent systematic review of vision and traffic safety studies in LMICs has painted a very different picture. The risk of crashes was elevated by 46% among those with vision impairment in a meta-analysis involving some two dozen studies. Poor vision was extremely common among road users in LMICs, including professional drivers. Finally, there was evidence of important policy failures: though the very large majority of countries have regulations stipulating the vision requirements for driving licensure, a number of studies in Piyasena et al.'s review reported that drivers with poor vision denied having undergone any sort of examination process in order to be allowed to drive.

Thus, vision and driving safety in LMICs is an important and understudied area for eye health researchers. In particular, RCTs are needed to demonstrate that low-cost vision care, such as provision of spectacles, can reduce crashes among visually impaired drivers. The ongoing STABLE trial in Vietnam,[46] assessing the impact of spectacle provision on driving safety among myopic University age motorcycle drivers, is the first RCT assessing the impact of vision care on traffic safety in LMICs. Such trials are challenging, due to the ethical problems inherent in delayed provision of vision care to participants in control groups. STABLE is ameliorating this concerned by employing a stepped wedge design, in which cohorts of drivers are followed, with eye examinations and spectacle provision, as needed, being delivered to these groups in randomised fashion. Data collected prior to provision of glasses is analysed in the control state, while information after glasses delivery is assessed as indicate of the intervention. The main trial outcome in STABLE is crash and near crash events as recorded by data acquisition systems, including motorcycle mounted cameras, gyroscopic systems, and small hard drives. Studies of naturalistic driving are particularly important in low resource settings, where traffic crashes are frequently not formally adjudicated, but rather are resolved by informal arrangements. Such studies have only become possible in recent years, thanks to the advances in camera and hard drive technology largely driven by mobile phone technology.

Unlike other types of medical treatment, absence of vision care is not directly associated with loss of life. In view of this fact, it is natural for health system planners to prioritise vision care below other aspects of the healthcare system such as pre and perinatal care and management of increasingly-common chronic conditions including diabetes and hypertension. If the global eye health community wishes to see increasing investment from governments in vision care, we must be prepared to supply a compelling rationale in the form of high-quality evidence of specific, economically-impactful benefits conferred by such investments. Trial data is of particular importance, as only experimental studies can deliver evidence of cause and effect. Costing, cost-effectiveness and cost-benefit analyses are also needed, as only these data can provide guidance for decision makers who must choose between vision care and other areas of health and development in which to invest. Similar types of evidence are equally important to drive investment from industry in manufacturing, agriculture and traffic-focused vision programmes. Encouragingly, costing and economic evaluations are generally less resource intensive than trials. This review has gathered existing data to make it readily available for advocacy, and more importantly, has pointed out new directions where additional high-quality evidence could be particularly impactful in swaying policy makers and growing investment in vision care.

Correction notice

None

Acknowledgement

None

Author Contributions

(I) Conception and design: Nathan Congdon
(II) Administrative support: Not applicable
(III) Provision of study materials or patients: Not applicable
(IV) Collection and assembly of data: All authors
(V) Data analysis and interpretation: Not applicable

(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 the ICMJE uniform disclosure form.

Patient consent for publication
None

Ethical Statement
None

Provenance and Peer Review
This article was a standard submission to our journal. The article has undergone peer review with our anonymous review system.

Data Sharing Statement
None

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