Impact of vision impairment and ocular morbidity and their treatment on quality of life in children: a systematic review

Li, D., Chan, V. F., Virgili, G., Mavi, S., Pundir, S., Singh, M. K., She, X., Piyasena, P., Clarke, M., Whitestone, N., Patnaik, J. L., Xiao, B., Cherwek, D. H., Negash, H., O'Connor, S., Prakalapakorn, S. G., Huang, H., Wang, H., Boswell, M., & Congdon, N. (2024). Impact of vision impairment and ocular morbidity and their treatment on quality of life in children: a systematic review. *Ophthalmology*, *131*(2), 188-207. https://doi.org/10.1016/j.ophtha.2023.09.005

Published in:
Ophthalmology

Document Version:
Publisher's PDF, also known as Version of record

AMERICAN ACADEMY OF OPHTHALMOLOGY®

Impact of Vision Impairment and Ocular Morbidity and Their Treatment on Quality of Life in Children

A Systematic Review

Dongfeng Li, MMed,[1,2,3,*] Ving Fai Chan, PhD,[3,*] Gianni Virgili, PhD,[3,4] Sonia Mavi, BSc,[3] Sheetal Pundir, PhD,[5] Manpreet K. Singh, PhD,[6] Xinshu She, PhD,[6] Prabhath Piyasena, PhD,[3] Mike Clarke, PhD,[3] Noelle Whitestone, MHA,[7] Jennifer L. Patnaik, PhD,[7,8] Baixiang Xiao, MD,[3,9] David H. Cherwek, MD,[7] Habtamu Negash, MBA,[7] Sara O'Connor, MD,[10] S. Grace Prakalapakorn, MD, MPH,[11,15] Huilan Huang, MD,[12] Huan Wang, PhD,[13] Matthew Boswell, MA,[13] Nathan Congdon, MD, MPH[3,7,14]

Topic: This review summarizes existing evidence of the impact of vision impairment and ocular morbidity and their treatment on children's quality of life (QoL).

Clinical Relevance: Myopia and strabismus are associated with reduced QoL among children. Surgical treatment of strabismus significantly improves affected children's QoL.

Methods: We conducted a systematic review and meta-analysis by screening articles in any language in 9 databases published from inception through August 22, 2022, addressing the impact of vision impairment, ocular morbidity, and their treatment on QoL in children. We reported pooled standardized mean differences (SMDs) using random-effects meta-analysis models. Quality appraisal was performed using Joanna Briggs Institute and National Institutes of Health tools. This study was registered with the International Prospective Register of Systematic Reviews (identifier, CRD42021233323).

Results: Our search identified 29 118 articles, 44 studies (0.15%) of which were included for analysis that included 32 318 participants from 14 countries between 2005 and 2022. Seventeen observational and 4 interventional studies concerned vision impairment, whereas 10 observational and 13 interventional studies described strabismus and other ocular morbidities. Twenty-one studies were included in the meta-analysis. The QoL scores did not differ between children with and without vision impairment (SMD, −1.04; 95% confidence interval [CI], −2.11 to 0.03; $P = 0.06$; 9 studies). Myopic children demonstrated significantly lower QoL scores than those with normal vision (SMD, −0.60; 95% CI, −1.09 to −0.11; $P = 0.02$; 7 studies). Children with strabismus showed a significantly lower QoL score compared with those without (SMD, −1.19; 95% CI, −1.66 to −0.73; $P < 0.001$; 7 studies). Strabismus surgery significantly improved QoL in children (SMD, 1.36; 95% CI, 0.48–2.23; $P < 0.001$; 7 studies). No randomized controlled trials (RCTs) concerning refractive error and QoL were identified. Among all included studies, 35 (79.5%) were scored as low to moderate quality; the remaining met all quality appraisal tools criteria.

Discussion: Reduced QoL was identified in children with myopia and strabismus. Surgical correction of strabismus improves the QoL of affected children, which supports insurance coverage of strabismus surgery. Further studies, especially RCTs, investigating the impact of correction of myopia on QoL are needed.

Financial Disclosure(s): Proprietary or commercial disclosure may be found in the Footnotes and Disclosures at the end of this article. *Ophthalmology 2024;131:188-207*

Supplemental material available at www.aaojournal.org.

In 2020, an estimated 596 million people worldwide were affected by distance vision impairment, and a further 510 million had uncorrected near vision impairment.[1] An estimated 70 million children 0 to 14 years of age have vision impairment, among whom 1.4 million have irreversible blindness.[2] Children with vision impairment often exhibit increased social isolation,[3] elevated risks of mental health problems developing,[4] poor school performance,[5] and reduced quality of life (QoL).[6,7]

In ophthalmic practice, vision function traditionally has been assessed by visual acuity. However, visual acuity alone does not always convey a person's perception of his or her visual impairment and ability to perform vision-related tasks.[8,9] Quality of life is a self-rated multidimensional

https://doi.org/10.1016/j.ophtha.2023.09.005
ISSN 0161-6420/23

concept incorporating physical, functional, social, and emotional well-being.[10] Measuring QoL provides a comprehensive overview of the affected person's experiences of an eye disease[8] and satisfaction with an ophthalmic treatment.[11] For example, strabismus surgery typically does not improve visual acuity, nor does it prevent vision loss, but it can be associated with significant emotional impact. Hence, evaluating surgical outcomes based on the patient's perspective is essential. Quality of life also supports clinical decision-making, can be used as a prognostic indicator, and may inform policy-making decisions for resource allocation.[12]

Ocular conditions affect all stages of life, with young children and older people particularly at risk.[2] During the past 2 decades, an increasing number of studies have investigated the impact of vision impairment and ocular morbidity on QoL in adults. It has been well established that vision impairment and ocular diseases can affect adults negatively, especially older people's mental health and QoL.[13] In 2021, Assi et al[13] conducted an umbrella review and found an association among vision impairment, eye disease, and lower QoL across the lifespan. However, most of the included systematic reviews focused on vision impairment and eye diseases that are common among older adults, but not children, such as age-related macular degeneration, glaucoma, and diabetic retinopathy. Additionally, chronic ocular conditions exist that do not impair vision, but do have other negative impacts that can reduce the QoL of affected children. For example, strabismus affects 5.0% to 6.8% of otherwise healthy children,[14,15] causing physical, educational, and socioemotional difficulties in their daily lives.[16,17] A narrative review conducted in 2021 found that strabismus can impact the well-being of children and adults negatively, and strabismus surgery can improve ocular alignment, psychosocial health, and QoL. However, the authors did not conduct a meta-analysis because of the high heterogeneity of included studies across the life course.[16]

To our knowledge, no systematic reviews or meta-analyses have assessed comprehensively the effect of vision impairment and ocular morbidity on QoL in children. In addition, results from available studies regarding eye health and QoL in children are not consistent. Some studies reported no significant difference in QoL between children with vision impairment and those without.[18–20] However, several other studies found that vision impairment or refractive error had a detrimental effect on children's QoL.[6,7,21] Therefore, this systematic review examined the impact of vision impairment and ocular morbidity on children's QoL and the effectiveness of ophthalmic interventions in improving QoL.

Methods

We performed a systematic review and meta-analysis in accordance with the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) checklist (Appendix 1). A protocol was registered and published on the International Prospective Register of Systematic Reviews (identifier, CRD42021233323). This is a systematic review and meta-analysis using de-identified participant data from all included studies. Informed consent was not obtained, and the Queen's University Belfast Ethics Committee agreed that approval was not required for this study. All research adhered to the tenets of the Declaration of Helsinki.

Search Methods for Identifying Studies

Li et al[4] described the search methods in detail. In brief, a comprehensive search was conducted using Medical Literature Analysis and Retrieval System Online (MEDLINE), Embase, Web of Science, PsycINFO, Cochrane Database of Systematic Reviews, the Cochrane Central Register of Controlled Trials in the Cochrane Library, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Chinese databases WANFANG MED ONLINE and China National Knowledge Infrastructure from inception through February 18, 2022, without language restriction. We repeated the search strategy on August 22, 2022. This search strategy was developed under an information specialist's guidance and was tested through an iterative process before finalizing the combination of terms (Appendix 2).

Eligibility Criteria

Studies meeting the following criteria were considered eligible for inclusion: (1) enrolled children or young adults, as long as the mean age of participants was younger than 18 years; (2) defined vision impairment according to the International Classification of Diseases, Eleventh Revision (2018), (presenting visual acuity, < 6/12); (3) observational studies should include a comparison group, such as normally sighted children; and (4) reported QoL outcomes (including generic, health related, or vision related). Studies using visual function questionnaires were also included, as long as the questionnaire contained subscales related to QoL or could be used to measure QoL, and (5) used either observational or intervention design, including randomized controlled trials (RCTs) and before-and-after studies with no control group. Only original studies published in peer-reviewed journals were included.

Studies were excluded if they met any of the following criteria: (1) the interventions were not ophthalmic; (2) the study compared different kinds of interventions without a placebo or control group; (3) the studies concerning retinoblastoma, retinopathy of prematurity, and uveitis were excluded because of potential complications other than vision; and (4) the study used a qualitative design.

Study Selection, Data Collection, and Risk of Bias Assessment

Two reviewers (D.L. and one of the following: P.P., S.M., H.H., and S.P.) independently screened all titles and abstracts for eligibility. Reviewers read the full-text articles for potentially eligible studies to determine final inclusion or exclusion. Two reviewers (D.L. and S.P.) extracted data independently into Excel version 2201 software (Microsoft Corporation). For observational studies, the extracted data consisted of the authors' names, publication year, study design, country, diagnosis, sample size, demographic characteristics of participants, instruments used to measure QoL, and a summary of findings. For interventional studies, beyond the characteristics listed above, we also recorded the type of intervention in each group. Any disagreement was resolved by discussion within the research team.

The risk of bias and quality of studies was assessed using the National Institutes of Health quality assessment tool for the before-and-after study without a control group and corresponding Joanna Briggs Institute critical appraisal checklists for cross-sectional and

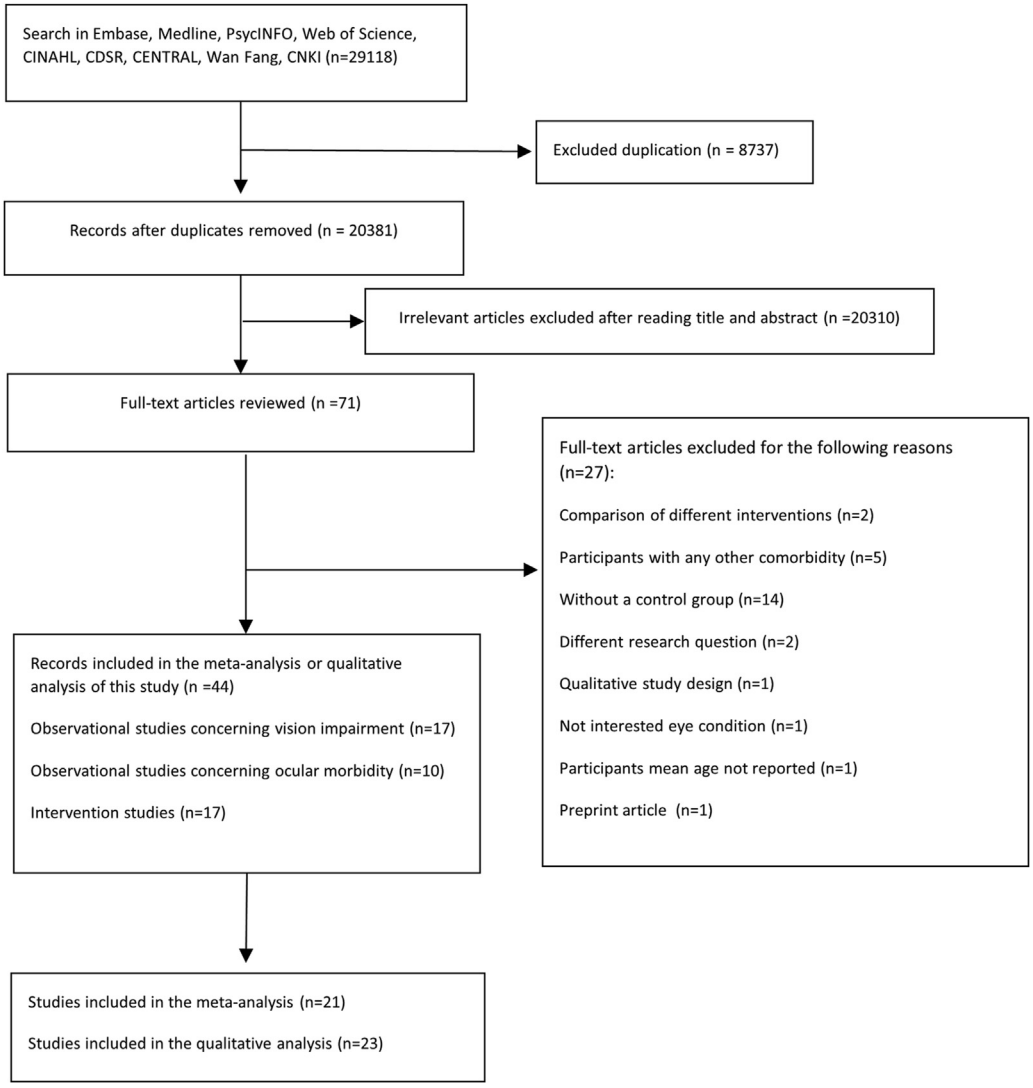


Figure 1. Flowchart of the study selection process.

RCT study designs. Two reviewers (D.L., S.P., and H.H. worked as the second) appraised the studies independently.

Data Synthesis and Analysis

Data analyses were conducted using Stata version 17.0 statistical software's meta suite of commands (StataCorp LLC). As described previously,[4] we reported vision impairment and strabismus separately. We expected that different studies would use a variety of tools to measure QoL; thus, standardized mean differences (SMDs) were used in the pooled analyses. A negative pooled SMD indicates that the eye disease is detrimental to QoL of children and vice versa. A random-effects model was used because of heterogeneity between studies, and data were displayed using a forest plot. To minimize heterogeneity, we included only self-reported QoL studies and excluded proxy-reported outcomes from the meta-analysis. A leave-one-out sensitivity analysis was conducted to evaluate the relative impact of studies on the meta-analytic outcomes. Studies not eligible for meta-analysis were included in a narrative description.

Results

Study Characteristics

Of the 29 118 references identified (28 992 via the first search and 126 after repeating the search strategy on August 22, 2022), 71 full-text articles (0.24%) were reviewed, and 44 studies (0.15%) were identified as eligible for systematic review (Fig 1). A list of excluded studies with reasons for exclusion is provided in Table S1 (available at www.aaojournal.org).

Among the 44 studies, 17 observational studies concerned vision impairment,[6,7,18,19,21–33] 10 observational studies described strabismus and other ocular morbidities,[20,34–42] 13 interventional studies involved strabismus,[43–55] and 4 interventional studies focused on vision impairment.[56–59] These studies were conducted between 2005 and 2022 and included 32 318 participants (median, 120 participants; interquartile range, 75–303 participants; range, 21–12 989 participants) from 14 countries. Only 4 studies (9.09 %) were from low-income countries, including 1 each from Iran[54] and Pakistan[25] and 2 from India.[39,57] Twenty-nine studies were from middle-income countries, including 1 each from South

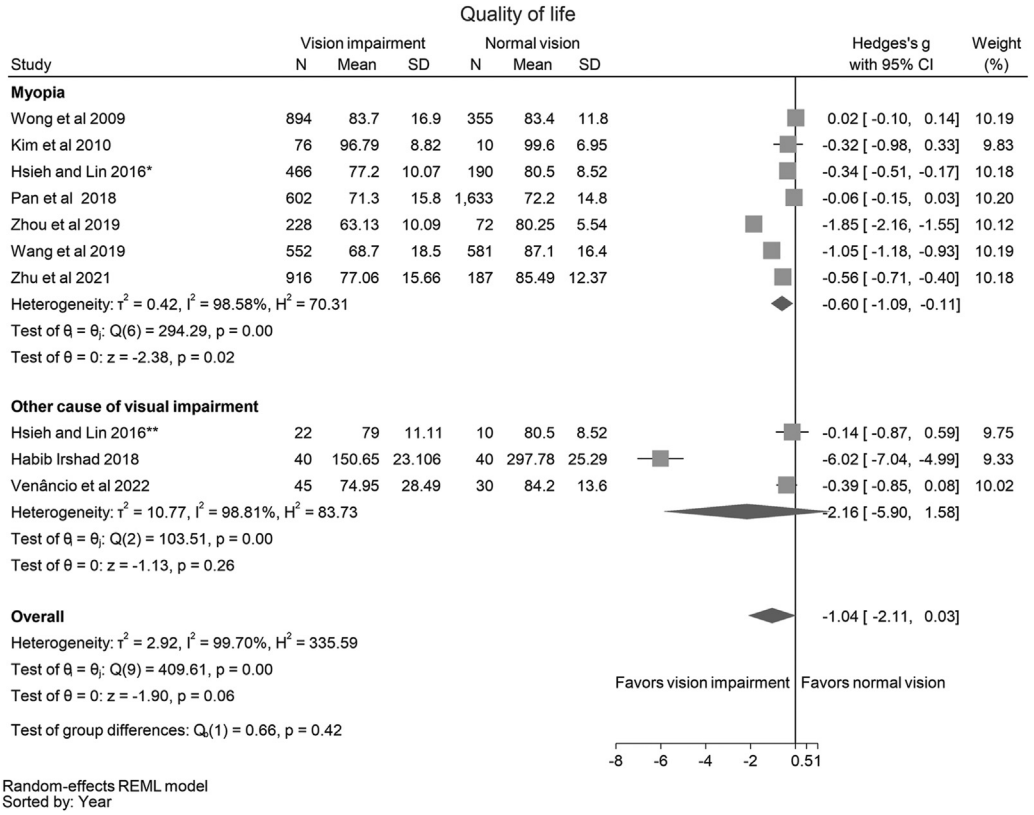


Figure 2. Forest plot of the random-effects model for the association between quality of life and vision impairment in children. CI = confidence interval; SD = standard deviation.

Africa[28] and Malaysia,[45] 2 from Brazil,[23,33] and 24 from China.[7,19,21,22,24,29,31,32,34,37,38,40,42,44,46,48,49,51–53,55,56,58,59] Twelve studies were from high-income countries, including 1 each from Germany,[35] Japan,[50] Portugal,[41] the United Kingdom,[6] and Korea[26]; 2 from Singapore[18,36]; and 5 from the United States.[20,27,30,43,47] Thirty-three studies contained an approximately equal number of male and female participants. Three studies[26,36,47] and 7 studies[6,19,29,42,43,51,57] included less than 40% males and females, respectively. Two studies did not report on the sex distribution of participants.[30,40] Thirty-five studies were hospital-based surveys, and the remaining 9 studies were school-based surveys. The characteristics of the studies are reported in Tables 2 and 3.

The studies used 13 different questionnaires to measure children's QoL. The most commonly used tools were the Intermittent Exotropia Questionnaire (n = 12),[30,36,38,40,45–49,52,53,55] the Pediatric QoL Inventory (n = 11),[7,18–21,26,29,33,34,42,51] and the 25-item National Eye Institute Visual Function Questionnaire (n = 7).[21,22,28,31,32,37,44] Other questionnaires included the RAND Health Insurance Study questionnaire,[43,54] the Pediatric Eye Questionnaire,[24,27] the World Health Organization QoL Scale,[25] the QoL Impact of Refractive Correction,[59] the scale of QoL for children with congenital bilateral cataract,[58] a self-developed questionnaire to assess the impact of amblyopia treatment on health-related QoL,[56] the Children's Visual Function Questionnaire,[23] the generic KINDL-R questionnaire,[35,39] the LV Prasad Functional Vision Questionnaire,[57] and the Low Vision QoL Questionnaire.[6] Nine of these instruments were condition specific and 4 were general.

Methodologic Quality of Included Studies

The risk of bias and methodologic quality of the 44 studies are summarized in Table 4. Overall, only 9 studies met all the criteria of the corresponding tools. The risk of bias and methodologic quality of the 20 observational studies were scored as low to moderate on the Joanna Briggs Institute checklist for cross-sectional studies; common problems were (1) inability to identify or address potential confounding factors (n = 18),[6,19,21–28,30,31,34,36,37,39–41] (2) lack of valid and reliable manner to measure the exposure (n = 8),[22,25,30,35–37,39,40] (3) failure to use objective and standard criteria to measure the condition (n = 9),[19,22,25,30,35–37,39,40] and (4) failure to describe the inclusion and exclusion criteria (n = 3).[25,28,35] Sixteen studies were scored as moderate on the Quality Assessment Tool for Before-After Studies With No Control Group, the most common issues being (1) absence of sample size justification (n = 14),[43,44,46–51,53–56,58,59] (2) failure to describe the intervention clearly (n = 9),[45,46,48,51,53–55,58,59] (3) failure to enroll all eligible participants (n = 3),[43,48,51] (4) loss to follow-up more than 20% (n = 1)[58], and (5) lack of clearly stated research question (n = 1).[59] Eight observational studies[7,18,20,23,33,38,42,51] and the only RCT concerning strabismus met all criteria on the Joanna Briggs Institute checklist.[52]

Quantitative Synthesis with Meta-analysis

The meta-analysis included 9 of the 17 observational studies concerned with vision impairment (Table S5, available at

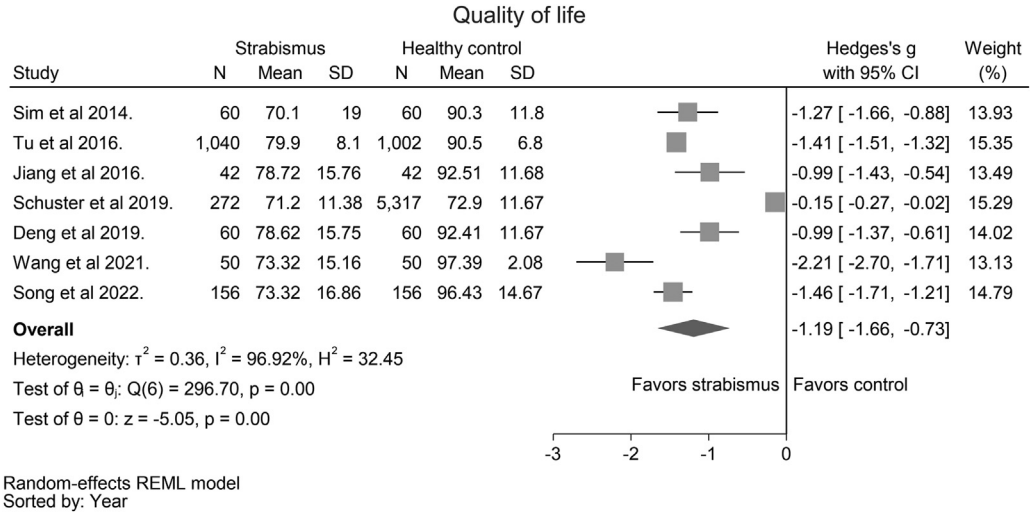


Figure 4. Forest plot of the random-effects model for the association between quality of life and strabismus in children. CI = confidence interval; SD = standard deviation.

www.aaojournal.org).[7,18,21,22,25,26,31–33] The QoL scores did not differ between children with and without vision impairment (pooled SMD, −1.04; 95% confidence interval [CI], −2.11 to 0.03; I^2 = 99.7%; P = 0.06; Fig 2). Subgroup analysis showed that in 7 studies[7,18,21,22,26,31,32] in which myopia was the cause of vision impairment, children showed statistically significantly lower QoL scores than children without refractive error (SMD, −0.60, 95% CI, −1.09 to −0.11; I^2 = 98.6%; P = 0.02; Fig 2). However, in 3 studies with other causes of vision impairment,[21,25,33] no significant difference was found compared with unaffected children (pooled SMD, −2.16; 95% CI, −5.90 to 1.58; I^2 = 98.8%; P = 0.26; Fig 2). After removing potential outlier studies, leave-one-out sensitivity analysis showed that the pooled effect size still suggested lower QoL scores in children with vision impairment compared with children with normal vision (Fig S3, available at www.aaojournal.org).

Five of the 9 observational studies and 2 interventional studies containing baseline data about strabismus were included in a meta-analysis (Table S6, available at www.aaojournal.org).[35–38,40,48,55] Children with strabismus showed significantly lower QoL scores than control groups (SMD, −1.19; 95% CI, −1.66 to −0.73; I^2 = 96.9%; P < 0.001; Fig 4). Leave-one-out sensitivity analysis showed that after removing potential outlier studies, the pooled effect size still suggested lower QoL scores in children with strabismus than children without strabismus (Fig S5, available at www.aaojournal.org).

Seven interventional studies[45–49,53,55] concerning strabismus surgery were included in a meta-analysis (Table S7, available at www.aaojournal.org). Strabismus surgery significantly improved the participants' QoL (SMD, 1.36; 95% CI, 0.48–2.23; I^2 = 98.4%; P < 0.001; Fig 6). Leave-one-out sensitivity analysis showed that after removing potential outlier studies, the pooled effect size still suggested that strabismus surgery improved affected children's QoL (Fig S7, available at www.aaojournal.org).

Qualitative Synthesis

Eight observational studies concerning vision impairment were not included in the meta-analysis because of the lack of a composite outcome score (n = 2),[19,23] proxy report of outcome (n = 1),[6] inability to separate myopia from other causes of refractive error (n = 1),[28] and research questions outside the scope of the meta-analysis (n = 4).[24,27,29,30] Children with vision impairment had 35.6% lower QoL scores than children with normal vision, even after receiving comprehensive visual rehabilitation.[6] Children with congenital bilateral cataracts had lower scores for vision-related QoL than unaffected control participants.[23] Children having undergone congenital or developmental cataract surgery still experienced a lower QoL and reduced functional vision.[24] Children with uncorrected refractive error and vision impairment had significantly lower QoL than those without.[28] Children with nonstrabismic amblyopia had similar QoL except for lower school function compared with healthy control participants.[19]

Results were inconsistent in 3 studies investigating the QoL of children wearing glasses for refractive error correction. Qian et al[29] reported that children with vision impairment who did not wear glasses scored lower in terms of psychosocial health, emotional health, and social functioning than similarly affected children who wore them, whereas the composite score did not differ significantly between these groups. Another study found that children who wore glasses to correct refractive error had significantly reduced eye-related QoL and functional vision compared with healthy control participants without glasses.[27] However, Yamada et al[30] reported that children who wore glasses to correct refractive error had similar self-report and proxy report scores on the Pediatric QoL Inventory compared with an unaffected control group without glasses.

Four studies investigated the impact of ophthalmic interventions on QoL in children with vision impairment.[56–59] A study using a before-and-after design found that the QoL scores of children with congenital bilateral cataracts were improved significantly after surgery. However, their QoL after the surgery was still lower than that of the children without cataract.[58] Another study indicated that the QoL scores of children with amblyopia did not differ before and after the treatment.[56] Two studies reported that orthokeratology and low-vision aids could improve the QoL of children with myopia[59] and low vision,[57] respectively.

Four observational studies concerning strabismus were not included in the meta-analysis because of the use of proxy-reported outcomes of QoL.[20,34,39,41] Wang et al[34] found that strabismus and amblyopia had a negative impact on children's daily life, learning, and psychological state. Wen et al[20] reported that strabismus was

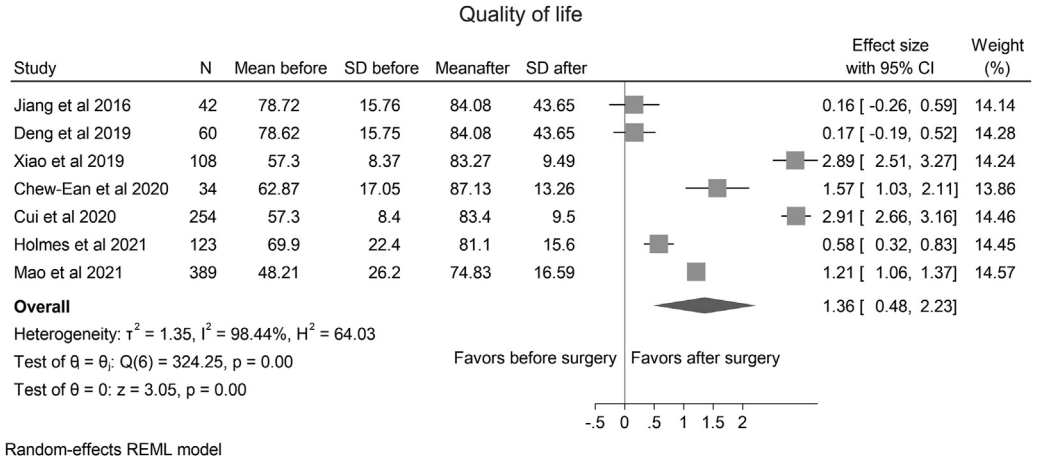


Figure 6. Forest plot of the random-effects model of the impact of strabismus surgery on quality of life in children. CI = confidence interval; SD = standard deviation.

associated with a significantly worse QoL in preschool children, whereas no association was found between amblyopia and QoL. Two studies did not provide composite QoL scores, although they found that children with strabismus had lower scores in some QoL domains than unaffected children.[39,41] Another study found that children with allergic conjunctivitis had significantly lower total QoL scores than an unaffected control group.[42]

Of the 6 interventional studies concerning strabismus not included in the meta-analysis of before-and-after study design, 1 study was an RCT,[52] 2 studies lacked original data,[44,50] 2 studies failed to report composite QoL scores,[43,54] and 1 study reported only a parent-proxy outcome.[51] These 6 studies all found that corrective strabismus surgery significantly improved the QoL score of the children with strabismus, as reported by the participants or their parents.[43,44,50–52,54]

Discussion

Quality of life increasingly is recognized as an important health outcome measure in clinical medicine. It reflects the World Health Organization's definition of health as "the state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity."[60] This is one of the initial systematic reviews and meta-analysis quantifying the association between vision impairment, ocular morbidities, and their treatment and QoL in children. The results strongly support the association between myopia and reduced QoL in children. We also observed a significant positive association between strabismus and diminished QoL in children. Most notably, this review found that surgical correction of strabismus can improve the QoL of affected children.

Children with vision impairment resulting from myopia had lower levels of QoL. Children with myopia have difficulties with distance- and near-vision functions,[21,31,32] which can affect school learning and other activities. Studies also report that children with myopia have lower school performance.[7] These measures are similar to the domains of QoL assessment, such as physical well-being, emotional well-being, and school functioning. Hence, it is not surprising that children with myopia had lower QoL. A previous systematic review found that myopia also is associated with greater symptoms of depression and anxiety.[4] Myopia is one of the leading causes of vision impairment, and although it can be corrected safely and in a cost-effective manner with glasses, in underserved areas only 15% to 20% of children requiring glasses have them.[5,61] More RCTs exploring the causal association between correction of myopia and QoL and mental health are needed in the future.

Subgroup analysis found that causes of vision impairment other than myopia did not impact the affected children's QoL. However, it should be noted that only 3 eligible studies were included in the meta-analysis and the largest sample size was 80, which made it difficult to detect differences. Nevertheless, studies in the qualitative synthesis indicated that children with cataract had reduced QoL. In addition, we identified several studies concerning the QoL of children with glaucoma and other vision impairment during the screening process,[62–65] in which glaucoma and its management have a marked impact on the affected children's QoL. Dahlmann-Noor et al[65] found that children with glaucoma had a QoL score similar to children with severe congenital cardiac defects or who have acute lymphoblastic leukemia. However, these studies did not meet our inclusion criteria because of the lack of a control group, and therefore were not included in the meta-analysis.

Observational studies found that strabismus affected QoL in children. Strabismus is characterized by a variety of ocular misalignments that can affect children's physical appearance and social interactions with others.[66] Children with strabismus have problems with emotional well-being and mental health problems.[20,34,35,37,44] They report worrying about what others think about them,[36,41,48] and their eye condition may affect their ability to make friends.[35] One study found that strabismus plays an important role in playmate selection.[67] In addition, children with strabismus report difficulties on function-related subscales such as near- and distance-vision activities, which also could contribute to reduced QoL.[37,44]

Table 2. Characteristics of Observational Studies Included in the Systematic Review (n = 27)

Author(s) (Year)	a) Country b) Study Design c) Setting d) Condition	a) Sample size b) Male (%) c) Age (yrs)*	a) Definition of Exposure b) Ascertainment of Exposure c) Control Group	Outcome Measurement Tool(s)	Summary of Findings
Bestilleiro Lopes et al (2009)[23]	a) Brazil b) Prospective observational cross-sectional c) Hospital d) Bilateral congenital cataracts	a) 69 b) 44.9 c) Study group > 3 yrs, 4.4 ± 1.5 yrs; < 3 yrs, 14.6 ± 10.7 mos; control group, 38 ± 17.3 mos	a) Not specified b) Measured via questionnaire c) Normal vision	CVFQ	Bilateral congenital cataracts influence vision-related QoL in children, confirmed by the low values obtained in the domains studied, most evidently in the competence domain.
Wong et al (2008)[18]	a) Singapore b) Cross-sectional c) School d) Visual impairment	a) 1249 b) 49.2 c) Study group, 13.8 ± 1.3; control group, 13.8 ± 1.4	a) Visual impairment was defined as presenting VA 0.3 logMAR in better-seeing eye, according to USA driving requirement b) Measured c) Normally sighted	PedsQL	Adolescents with vision impairment experienced statistically significantly impaired health-related QoL compared with normally sighted control group. However, refractive error did not have an impact on QoL.
Kim et al (2010)[26]	a) Korea b) Cross-sectional c) School d) Myopia	a) 92 b) 38.4 c) 12.58 ± 0.5	a) Myopia defined as SRE < −0.50 D and emmetropia as SRE −0.5−+1.0 D b) Measured c) Emmetropia	Peds QL	Refractive errors do not have a great impact on the total health-related QoL in elementary school children, but refractive errors cause discomfort in physical health and social functioning.
Chadha and Subramanian (2010)[6]	a) United Kingdom b) Cross-sectional c) Hospital d) Vision impairment	a) 48 b) 67.7 c) Study group, 10.13 ± 2.89; control group, 9.83 ± 2.81	a) Children with VI had VA in the better eye of 0.30 logMAR b) Medical record c) With no visual disability	LVQOL	Children with VI had significantly lower QoL scores than the comparison group ($P < 0.001$), resulting in a 35.6% reduction in total QoL scores.
Wen et al (2011)[20]	a) USA b) Cross-sectional c) Hospital d) Strabismus and amblyopia	a) 6072 b) Amblyopia:, 48.8; strabismus, 50.3 c) Range, 25−72 mos	a) Amblyopia defined as 2-line difference in VA between eyes (20/32 or worse in the worse eye) with corresponding unilateral amblyopia risk factor (strabismus, anisometropia, or visual axis occlusion) or bilaterally decreased VA (worse than 20/50, or worse than 20/40 if ≥ 48 mos of age) with a bilateral amblyopia risk factor (bilateral visual axis occlusion or bilateral high ametropia) b) Measured c) Without strabismus or amblyopia	Peds QL	Strabismus was associated with significantly worse GHRQOL in preschool children, although the association between amblyopia and GHRQOL was not detected.

Yamada et al (2011)[30]	a) USA b) Cross-sectional c) Hospital d) Refractive error	a) 49 b) Not specified c) Median, 8 (5–13)	a) Not specified b) Not specified c) Without refractive and strabismus	IXTQ and Peds QL	No difference was found between spectacle and no-spectacle groups when Child IXTQ, Proxy IXTQ, Child PedsQL, or Proxy PedsQL was used.
Sim et al (2013)[36]	a) Singapore b) Cross-sectional c) Hospital d) Strabismus	a) 120 b) 38.3% c) Strabismus, 8.7 ± 2.8; control, 8.5 ± 3.0	a) Not specified b) Medical record c) With no eye conditions	IXTQ	The IXTQ mean score for the strabismus group was statistically significantly lower than that for the control group ($P < 0.001$).
Hsieh and Lin (2015)[21]	a) China, Taiwan b) Cross-sectional c) School d) Refractive error	a) 688 b) 49.8 c) 16	a) Myopia defined as SRE < −0.50 D, hyperopia defined as SRE > +1.0 D, and emmetropia defined as SRE −0.5–+1.0 D b) Medical record c) Emmetropia	Chinese version of the NEI-VFQ-25	Children with myopia had statistically significantly lower QoL than children with emmetropia ($P < 0.01$).
Tu et al (2016)[37]	a) China b) Cross-sectional c) Hospital and school d) Strabismus	a) 2042 b) 46.0 c) Study group, 15.6 ± 1.2; control group, 15.8 ± 1.3	a) Not specified b) Medical record c) Normal vision participants	NEI-VFQ-25	Statistically significantly lower vision-related QoL scores were found in Chinese Han teenagers with strabismus compared with those without strabismus.
Habib and Irshad (2018)[25]	a) Pakistan b) Cross-sectional c) School for the blind and hospital d) Vision impairment	a) 80 b) 47.3 c) Range, 13–18	a) Not specified b) Medical record b) Normally sighted	WHOQOL	Visually impaired adolescents experienced an overall lower QoL and also showed low scores in all 4 domains—physical health, psychological, social relationships, and environment—compared with sighted peers.
Pan et al (2018)[7]	a) China b) Cross-sectional c) School d) Reduced vision	a) 2235 b) 51.8 c) 13.8 ± 0.8	a) Reduced VA defined as presenting VA of worse than 6/12 b) Measured c) Normally sighted	Peds QL	Healthy adolescents with reduced VA reported lower HRQoL scores.
Qian et al (2018)[29]	a) China b) Cross-sectional c) School d) Visual impairment	a) 483 b) 61.7 c) Children who used spectacles, 13.7 ± 0.8; Children who did not use spectacles, 13.8 ± 0.8	a) Refractive errors estimated based on the SE refraction (spherical power + 0.5 × cylindrical power) b) Measured c) Children with URE did not use spectacles	Peds QL	Adolescents not using spectacles had a statistically significantly lower HRQOL score compared with those using spectacles in terms of psychosocial health (65.91 vs. 70.59; $P = 0.028$), emotional health (56.85 vs. 63.24; $P = 0.012$), and social functioning (72.99 vs. 78.60; $P = 0.036$). However, the total scores of the two groups were similar.
Zhou (2019)[22]	a) China b) Cross-sectional c) School d) Myopia	a) 300 b) 50.3 c) Not specified	a) Myopia defined as VA < 5.0 b) Measured c) Normally sighted	NEI-VFQ-25	Myopia may impact children's QoL ($P < 0.05$).

Schuster et al (2019)[35]	a) Germany b) Cross-sectional c) Hospital d) Strabismus	a) 12 989 b) 51.1 c) Range, 3−17	a) Past or present occurrence of strabismus was obtained by asking: "Has your child ever had a visual dysfunction?" b) Through question c) Children without strabismus	The KINDL-R questionnaire	Children with strabismus had lower scores in both the parent-reported and self-reported KINDL-R total scale.
Wang et al (2020)[34]	a) China b) Cross-sectional c) School and hospital d) Strabismus and amblyopia	a) 298 b) 53.4 c) Range, 3−16	a) According to the guidelines for the diagnosis and treatment of strabismus and amblyopia (2018) b) Measured c) Emmetropia	Peds QL	Strabismus and amblyopia can have a great negative impact on children's daily life, learning, and psychological features.
Leske et al (2019)[27]	a) USA b) Cross-sectional c) Hospital d) Refractive error	a) 139 b) 51.1 c) Range, 5−17	a) Normal thresholds of VA for each year of age were defined based on previously published normal values b) Measured c) Normal control	Ped EyeQ	In this study, glasses wearers had reduced eye-related QOL and functional vision compared with control participants.
Wang et al (2021)[38]	a) China b) Cross-sectional c) Hospital d) Intermittent exotropia	a) 100 b) 43 c) Study group, 8.3 ± 4.2 (5−16); control group, range, 5−16	a) Not specified b) Measured c) Without strabismus	IXTQ	The QoL of children with intermittent exotropia was statistically significantly lower than that of the control group ($P < 0.001$).
Zhu et al (2021)[31]	a) China b) Cross-sectional c) School d) Myopia	a) 1103 b) 53.0 c) Myopia, 15.63 ± 0.63 (13−18); control group, 15.57 ± 0.59 (13−18)	a) Mild myopia group, SE < 3.00 D; moderate myopia group, SE, 3.00−6.00 D; severe myopia group, SE > 6.00 D b) Measured c) Normally sighted	NEI-VFQ-25	Senior first-year myopia students have lower QoL scores than students with normal vision.
Gu et al (2022)[24]	a) China b) Cross-sectional c) Hospital d) Congenital cataract	a) 166 b) 41.6 c) Range, 0−11	a) Not specified b) Medical record c) Visually healthy control	Ped EyeQ	Children who have undergone congenital and developmental cataract surgery experience a lower QoL and reduced functional vision.

Magakwe et al (2022)[28]	a) South Africa b) Cross-sectional c) School d) Refractive error and VI	a) 154 b) 47.4 c) 16.59 ± 1.42 (14–18)	a) Refractive error was classified according to the RESC protocol where myopia was defined as an autorefractor value of ≥ −0.50 D in one or both eyes, a value of +2.00 D or more in one or both eyes as hypermetropia, and a value of ≥ −0.75 cylindrical refraction in one or both eyes as astigmatism. Any child who scored between 0.0 M (minimum angle of resolution) and < 0.2 M in both eyes, through the autorefractor findings, on the logMAR chart was considered to have good vision, a score of 0.2 M or worse in one or both eyes was considered to be URE, whereas a score of 0.3 or worse in one or both eyes was considered VI b) Measured c) Sighted children	NEI-VFQ-25	Children with URE and VI scored low on the NEI-VFQ-25 as compared with those without URE and VI.
Zhang et al (2021)[42]	a) China b) Case-control c) Hospital d) Allergic conjunctivitis	a) 188 b) 64.4 c) 9.31 ± 2.73 (5–18)	a) The diagnosis of allergic conjunctivitis was based on the diagnostic criteria of the American Academy of Ophthalmology for conjunctivitis b) Measured c) Healthy children	Peds QL	Allergic conjunctivitis has a negative association with health-related QoL for children and their parents, especially in children with vernal keratoconjunctivitis or atopic keratoconjunctivitis or with higher corneal fluorescein staining scores.
Venâncio et al (2022)[33]	a) Brazil b) Cross-sectional c) Hospital d) VI	a) 75 b) 42.7 c) Binocular VI, 9.9 ± 3.8 (4–15); monocular VI, 11.2 ± 2.2 (4–15); control group, 9.1 ± 3.3 (4–15)	a) Definition of VI was that of the ICD-10 version for 2019 b) Measured c) Children without eye diseases other than mild ametropias, best-corrected VA of 20/25	Peds QL	Child self-reported score for the binocular VI group was lower when compared with control participants in all 4 score scales. Compared with monocular children, the binocular group scored lower in physical health and social functioning.
Wang et al (2022)[19]	a) China b) Cross-sectional c) Hospital d) Nonstrabismic amblyopia	a) 80 b) 63.75 c) Nonstrabismic amblyopia, 15.64 ± 1.13 (12–18); healthy group, 15.89 ± 1.57 (12–18)	a) Not specified b) Measured c) Without nonstrabismic amblyopia	Peds QL	Healthy children had statistically significantly higher school functioning scores compared with children with nonstrabismic amblyopia, whereas the difference in the total quality of life was not statistically significant.

Wang and Wang (2019)[32]	a) China b) Cross-sectional c) School d) Myopia	a) 1133 b) Myopia group, 45.8 c) Myopia group, 10.0 ± 2.0 (8–14)	a) High myopia group, SE ≤ −6.0 D in either eye; moderate myopia group, −6.0 D < SE ≤ −3 D in either eye; (3) mild myopia group, −3.0 D < SE ≤ −0.5 D in either eye b) Measured c) Children with normal vision	NEI-VFQ-25	Children with myopia had lower scores of visual function-related QoL in all the domains compared with children with normal vision.
Silva et al (2022)[41]	a) Portugal b) Cross-sectional c) Hospital d) Strabismus	a) 63 b) 59 c) Strabismus group, 6 ± 4; normal vision group, 5 ± 2 (0–17)	a) The angle of deviation was measured using a prism and alternate cover test and corresponded to the largest prism magnitude that neutralized the deviation. It was defined as small (< 10 PD), medium (10–39 PD), and large (> 40 PD). b) Measured c) Children with normal vision	Ped EyeQ	All PedEyeQ domain scores were statistically significantly lower in children with strabismus compared with visually normal children, except the children in the "functional vision" domain.
Song et al (2022)[40]	a) China b) Cross-sectional c) Hospital d) Intermittent exotropia	a) 312 b) Not specified c) Intermittent exotropia group, 8.3 ± 2.2; healthy group, 8.8 ± 2.6	a) NA b) NA c) Healthy children	IXTQ	Children with intermittent exotropia had statistically significantly lower scores on IXTQ compared with healthy children ($P < 0.001$).
Merchant et al (2019)[39]	a) India b) Cross-sectional c) Hospital d) Strabismus	a) 73 b) 56.2 c) Range, 6–17	a) NA b) NA c) Healthy siblings	KINDL questionnaire	Children with strabismus scored lower on family and social contacts of the KINDL questionnaire compared with their healthy siblings.

CVFQ = Children's Visual Function Questionnaire; D = diopter; GHRQOL = General Health-Related Quality of Life; HRQoL = Health-Related Quality of Life; ICD-10 = International Statistical Classification of Diseases and Related Health Problems, Tenth Revision; IXTQ = Intermittent Exotropia Questionnaire; KINDL-R = German generic Quality of life tool for children; logMAR = logarithm of the minimum angle of resolution; LVP FVQ = LV Prasad Functional Vision Questionnaire; LVQOL = Low Vision QoL Questionnaire; NA = not applicable; NEI-VFQ-25 = 25-item National Eye Institute Visual Function Questionnaire; PD = prism diopter; Ped EyeQ = Pediatric Eye Questionnaire; Peds QL = Pediatric Quality of Life; QoL = quality of life; SD = standard deviation; SE = spherical equivalent; SRE = spherical refractive error; URE = uncorrected refractive error; USA = United States of America; VA = visual acuity; VI = visual impairment; WHOQOL = World Health Organization QoL Scale. In the Yamada study,[30] the median age is 8 and the range is 5-13.
*Presented as mean ± SD (range), unless otherwise indicated.

Table 3. Characteristics of Interventional Studies Included in the Systematic Review (n = 17)

Authors (Year)	a) Country b) Study Design c) Setting d) Condition	a) Sample Size b) Male sex (%) c) Age (yrs)*	Intervention	a) Definition of Exposure b) Outcome Measurement Tool(s)	Summary of Findings
Jiang et al (2016)[48]	a) China b) Before-and-after studies with no control group c) Hospital d) IXT	a) 42 b) 48 c) Range, 5–17	Strabismus surgery	a) Measured ≥ 15 PD at a distance or near a simultaneous prism cover test. b) IXTQ	Surgical treatment may improve HRQoL.
Morita et al (2020)[50]	a) Japan b) Before-and-after studies with no control group c) Hospital d) IXT	a) 21 b) 47.6 c) 8.6 ± 3.2 (5–16)	Strabismus surgery	a) Not specified b) PedsQL	The general HRQoL significantly improved after surgery in pediatric patients with IXT, although the improvement was considerably underestimated by the parents.
Chen et al (2016)[56]	a) China b) Before-and-after studies with no control group c) Hospital d) Amblyopia	a) 44 b) 48 c) 8.43 ± 1.34 (7–12)	Patching	a) Not specified b) Self-developed questionnaire to assess the impact of amblyopia treatment on HRQoL in children	In the sixteenth week of treatment, the scores were statistically significantly higher than before treatment in the psychosocial aspect ($P = 0.003$), but remained lower in visual function ($P < 0.001$), and no statistically significant differences were found in total scale ($P = 0.207$).
Wang et al (2015)[52]	a) China b) RCT c) Hospital d) IXT	a) 130 b) 46.9 c) Intervention group, 10.5 ± 2.4; control group, 10.5 ± 2.3	Divergence excess exotropia was treated with bilateral lateral rectus recession surgery; other types of exotropia were treated with unilateral recession-resection surgery	a) Divergence excess (defined as a deviation of at least 15° larger at distance than at near fixation after at least 45 min of unilateral occlusion) or basic type exotropia, and angle of deviation at distance and near fixation between 20° and 45° b) IXTQ	Corrective strabismus surgery significantly improved the HRQOL scores of children with IXT.
Chai et al (2009)[44]	a) China b) Prospective interventional c) Hospital d) Strabismus	a) 120 b) 46.7 c) Heterophoria, 8.3 ± 2.8; heterotopia, 8.4 ± 2.6	Strabismus surgery	a) Not specified b) The Chinese version of the NEI-VFQ-25	Compared with preoperative values, statistically significant improvements were noted after surgery in NEI-VFQ-25 summary score ($P < 0.05$).
Ye et al (2007)[58]	a) China b) Before-and-after studies with no control group c) Hospital d) Cataract	a) 36 b) 54.3 c) 9.8 ± 2.6	Cataract surgery	a) Congenital cataract b) Scale of QoL for children with congenital bilateral cataract	Surgical treatment can improve QoL of children with nondense cataract significantly.

Ziaei et al (2016)[54]	a) Iran b) Before-and-after studies with no control group c) Hospital d) Strabismus	a) 87 b) 47.1 c) 8.7 ± 4 (5–15)	Strabismus surgery	a) Congenital strabismus b) Modified RAND Health Insurance Study questionnaire	Most QoL dimensions improved after strabismus surgery, including functional limitation, anxiety, depression, positive well-being, social relations, general health perception, resistance/susceptibility, satisfaction with development, and eye alignment concerns.
Zhao et al (2018)[59]	a) China b) Before-and-after studies with no control group c) Hospital d) Myopia	a) 69 b) 55.1 c) 10.88 ± 1.76 (8–14)	Orthokeratology	a) Not specified b) QIRC	Orthokeratology lenses positively affect children's QoL, behaviors, and psychology.
Xiao et al (2019)[53]	a) China b) Before-and-after studies with no control group c) Hospital d) IXT	a) 122 b) 52.5 c) 7.0 ± 3.0 (2–15)	Strabismus surgery	a) Not specified b) The Chinese version of IXTQ	Strabismus surgery can improve the QoL of children with IXT effectively 1 year after surgical treatment.
Cui et al (2020)[46]	a) China b) Before-and-after studies with no control group c) Hospital d) IXT	a) 254 b) 54.7 c) 11.1 ± 1.5 (8–17)	Strabismus surgery	a) Not specified b) The Chinese version of IXTQ	Strabismus surgery can improve children's QoL significantly.
Archer et al (2005)[43]	a) USA b) Before-and-after studies with no control group c) Hospital d) Strabismus	a) 98 b) 61.4 c) 4.5 ± 3.3	Strabismus surgery	a) Not specified b) Modified version of the RAND Health Insurance Study questionnaire	Statistically significant improvements were observed in all of the subscales except positive well-being and parent–child closeness ($P < 0.05$) after strabismus surgery.
Chew et al (2020)[45]	a) Malaysia b) Before-and-after studies with no control group c) Hospital d) IXT	a) 34 b) 44.1 c) 10.59 ± 2.71 (8–17)	Strabismus surgery	a) Not specified b) IXTQ	Surgery statistically significantly improved the QoL score in Malaysian children with infantile esotropia and their parents or guardians.
Qian et al (2021)[51]	a) China b) Before-and-after studies with no control group c) Hospital d) Strabismus	a) 83 b) 61.4 c) 7.86 ± 3.8 (3–17)	Strabismus surgery	a) According to guidelines for the diagnosis and treatment of strabismus and amblyopia (2018) b) PedsQL	Statistically significant improvements in QoL total scores ($P < 0.05$) were observed 1 month after strabismus surgery.
Mao et al (2021)[49]	a) China b) Before-and-after studies with no control group c) Hospital d) IXT	a) 389 b) 47.8 c) 8.17 ± 2.81 (5–17)	Strabismus surgery	a) Basic type (the deviation was within 10 PD at a distance and near), (3) angle of distant exodeviation ≥ 15 PD b) IXTQ	The HRQoL of children with IXT improved statistically significantly after surgery.

Holmes et al (2021)[47]	a) USA b) Before-and-after studies with no control group c) Hospital d) IXT	a) 197 b) 38.1 c) Range, 3—11	Strabismus surgery	a) In brief, 197 children 3 to < 11 yrs of age with basic-type IXT were enrolled in the original RCT, measuring 15—40 D by prism and alternate cover test at distance fixation, with near stereoacuity of ≥ 400 arcsec on the Randot Preschool Stereotest (Stereo Optical Co.) b) IXTQ	Overall, mean IXTQ domain scores improved statistically significantly for all domains from baseline to 36 mos after surgery.
Kavitha et al (2020)[57]	a) India b) Longitudinal before-and-after studies with no control group c) Hospital d) Low vision	a) 30 b) 66.7 c) 12.27 ± 2.97	Low-vision aids	a) BCVA < 0.5 logMAR (< 6/18 Snellen chart) in the better eye (WHO definition of low vision) b) Measured	A statistically significant improvement in the vision-related QOL ($P < 0.001$) as well as the baseline BCVA ($P = 0.002$) was found 3 months after using low-vision aids.
Deng and Luo (2019)[55]	a) China b) Before-and-after studies with no control group c) Hospital d) IXT	a) 60 b) 51.67 c) 11.23 ± 2.10 (5—16)	Strabismus surgery	a) Not specified b) IXTQ	Strabismus surgery statistically significantly improved the total score of IXTQ in children with IXT.

BCVA = best-corrected visual acuity; HRQoL = health-related quality of life; IXT = intermittent exotropia; IXTQ = Intermittent Exotropia Questionnaire; logMAR = logarithm of the minimum angle of resolution; LV = low vision; NEI-VFQ-25 = 25-item National Eye Institute Visual Function Questionnaire; PD = prism diopter; Peds QL = Pediatric Quality of Life; QIRC = QoL Impact of Refractive Correction; QoL = quality of life; RCT = randomized controlled trial; RAND = research and development; SD = standard deviation; WHO = World Health Organization.
*Presented as mean ± SD (range), unless otherwise indicated.

Table 4. Checklist Results for Assessing the Methodologic Quality of the Selected Studies (n = 44)

Study Type	Question												
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Cross-sectional													
Lopes et al (2009)	✓	✓	✓	✓	✓	×	✓	✓					
Wong et al (2009)	✓	✓	✓	✓	✓	✓	✓	✓					
Kim et al (2010)	✓	✓	✓	✓	×	×	✓	✓					
Yamada et al (2010)	✓	✓	±	±	×	×	✓	✓					
Chadha et al (2011)	✓	✓	✓	✓	×	×	✓	✓					
Wen et al (2011)	✓	✓	✓	✓	✓	✓	✓	✓					
Sim et al (2013)	✓	✓	±	±	✓	×	✓	✓					
Hsieh et al (2016)	✓	✓	✓	✓	✓	×	✓	✓					
Tu et al (2016)	✓	✓	±	±	✓	×	✓	✓					
Habib et al (2018)	×	✓	±	±	×	×	✓	✓					
Pan et al (2018)	✓	✓	✓	✓	✓	✓	✓	✓					
Qian et al (2018)	✓	✓	✓	✓	✓	✓	✓	✓					
Merchant et al (2019)	✓	✓	±	±	✓	×	✓	✓					
Schuster et al (2019)	×	✓	×	×	✓	✓	✓	✓					
Wang et al (2019)	✓	✓	✓	✓	✓	✓	✓	✓					
Zhou et al (2019)	✓	✓	×	×	×	×	✓	✓					
Leske et al (2020)	✓	✓	✓	✓	✓	×	✓	✓					
Wang et al (2020)	✓	✓	✓	✓	×	×	✓	✓					
Wang et al (2021)	✓	✓	✓	✓	✓	✓	✓	✓					
Zhang et al (2021)	✓	✓	✓	✓	✓	✓	✓	✓					
Zhu et al (2021)	✓	✓	✓	✓	✓	×	✓	✓					
Gu et al (2022)	✓	✓	✓	✓	✓	×	✓	✓					
Magakwe et al (2022)	±	✓	✓	✓	×	×	✓	✓					
Silva et al (2022)	✓	✓	✓	✓	✓	×	✓	✓					
Song et al (2022)	✓	✓	±	±	×	×	✓	✓					
Venâncio et al (2022)	✓	✓	✓	✓	✓	✓	✓	✓					
Wang et al (2022)	✓	✓	✓	±	✓	×	✓	✓					
Before-and-after studies with no control group													
Archer et al (2005)	✓	✓	×	×	※	✓	✓	♦	✓	✓	♦	♦	
Ye et al (2007)	✓	✓	※	✓	※	×	✓	♦	×	✓	♦	♦	
Chai et al (2009)	✓	✓	✓	✓	※	✓	✓	♦	✓	✓	♦	♦	
Chen et al (2015)	✓	✓	※	✓	※	✓	✓	♦	✓	✓	♦	♦	
Jiang et al (2016)	✓	✓	※	※	※	×	✓	♦	✓	✓	♦	♦	
Ziaei et al (2016)	×	✓	✓	✓	※	♦	✓	♦	✓	✓	♦	♦	
Zhao et al (2018)	×	✓	※	×	※	×	✓	♦	✓	✓	♦	♦	
Deng et al (2019)	✓	✓	※	✓	※	×	✓	♦	✓	✓	♦	♦	
Kavitha et al (2019)	✓	✓	※	✓	✓	✓	✓	♦	✓	✓	♦	♦	
Xiao et al (2019)	✓	×	※	✓	※	×	✓	♦	✓	✓	♦	♦	
Chew et al (2020)	✓	✓	✓	✓	✓	×	✓	♦	✓	✓	♦	♦	
Cui et al (2020)	✓	✓	✓	✓	※	×	✓	♦	✓	✓	♦	♦	
Holmes et al (2021)	✓	✓	✓	✓	※	✓	✓	♦	✓	✓	♦	♦	
Mao et al (2021)	✓	✓	✓	✓	※	✓	✓	♦	✓	✓	♦	♦	
Morita et al (2021)	✓	✓	✓	✓	※	✓	✓	♦	✓	✓	♦	♦	
Qian et al (2021)	✓	✓	✓	×	※	×	✓	♦	✓	✓	♦	♦	
Randomized controlled trial													
Wang et al (2015)	✓	✓	✓	♦	♦	♦	✓	✓	✓	✓	✓	✓	✓

✓ = yes, the study satisfactorily met the respective quality criterion; × = no, the study did not meet the respective quality criterion; ♦ = not applicable; ± = unclear whether the study met the respective quality criterion; ※ = cannot determine.

Joanna Briggs Institute tool questions for cross-sectional study assessment: 1: Were the criteria for inclusion in the sample clearly defined?; 2: Were the study subjects and the setting described in detail?; 3: Was the exposure measured in a valid and reliable way?; 4: Were objective, standard criteria used for measurement of the condition?; 5: Were confounding factors identified?; 6: Were strategies to deal with confounding factors stated?; 7: Were the outcomes measured in a valid and reliable way?; 8: Was appropriate statistical analysis used? (Joanna Briggs Institute, 2020).

National Institutes of Health tool questions for before-and-after studies with no control group study assessment: Q1: Was the study question or objective clearly stated?; 2: Were eligibility/selection criteria for the study population prespecified and clearly described?; 3: Were the participants in the study representative of those who would be eligible for the test/service/intervention in the general or clinical population of interest?; 4: Were all eligible participants that met the prespecified entry criteria enrolled?; 5: Was the sample size sufficiently large to provide confidence in the findings?; 6: Was the test/service/intervention clearly described and delivered consistently across the study population?; 7: Were the outcome measures prespecified, clearly defined, valid, reliable, and assessed consistently across all study participants?; 8: Were the people assessing the outcomes blinded to the participants' exposures/interventions?; 9 Was the loss to follow-up after baseline 20% or less? Were those lost to follow-up accounted for in the analysis?; 10 Did the statistical methods examine changes in outcome measures from before to after the intervention? Were statistical tests done that provided *P* values for the pre-to-post changes?; 11: Were outcome measures of interest taken multiple times before the intervention and multiple times after the intervention (i.e., did they use an

interrupted time-series design)?; 12 If the intervention was conducted at a group level (e.g., a whole hospital, a community, etc.) did the statistical analysis take into account the use of individual-level data to determine effects at the group level? (National Heart, Lung, and Blood Institute, 2021).
Joanna Briggs Institute tool questions for randomized controlled trials study assessment: Q1: Was true randomization used for assignment of participants to treatment groups?; 2: Was allocation to groups concealed?; 3: Were treatment groups similar at the baseline?; 4: Were participants blind to treatment assignment?; 5: Were those delivering treatment blind to treatment assignment?; 6: Were outcomes assessors blind to treatment assignment?; 7: Were treatment groups treated identically other than the intervention of interest?; 8: Was follow-up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?; 9: Were participants analyzed in the groups to which they were randomized?; 10: Were outcomes measured in the same way for treatment groups?; 11: Were outcomes measured in a reliable way?; 12: Was appropriate statistical analysis used?; 13: Was the trial design appropriate for the topic, and any deviations from the standard RCT design accounted for in the conduct and analysis?" (Joanna Briggs Institute, 2020).

All 13 interventional studies found that surgical correction of strabismus could improve the QoL score in affected children, possibly because of the changes in appearance and functional recovery of binocular vision after the surgery. Interestingly, even children with unsuccessful surgery (defined as residual deviation of $>$ 10 prism diopters) reported improved QoL.[43,49,52,54] One possibility is that the placebo effect of surgery contributes to the patients' improved QoL. Previous studies found that the clinical severity of strabismus measured by the angle of deviation was not correlated with QoL in children and adults, indicating that clinical measures of strabismus may be unrelated to QoL.[66,68] Although surgery can improve affected children's QoL, the value of strabismus surgery usually is underestimated, and such operations often are regarded as cosmetic surgery, even by some ophthalmologists.[69] Moreover, strabismus surgery is not covered by health insurance in some countries with limited resources, such as China,[70] India,[71] and Vietnam,[72] possibly imposing a financial burden on affected people and limiting their motivation and ability to choose surgery.

Quality of life is assessed from a patient's perspective. However, very young or severely disabled children may be unable to self-report reliably on information related to complex health-related constructs, and reporting by a parent proxy may be required. In these instances, the agreement between parents' and children's reports of a child's QoL often is high for objective externalizing domains such as walking and running, whereas less concordance is observed for internalizing, emotion-based domains such as pain, sadness, and worry.[73] In this review, 7 studies relied solely on parent-proxy reporting,[6,20,24,34,43,51,54] whereas the rest used self-reported or a combination of self-reported and parent-proxy QoL scoring. Discrepancies occurred between parent proxy and child self-reports both in observational[18,30,35,36] and interventional[50,52] studies. To minimize heterogeneity, we excluded proxy-reported outcomes from the meta-analysis. Further study is needed to understand better the reasons for differences between self-reporting and proxy reporting of QoL in children with ocular conditions. Generic measures may be less sensitive to detecting disease impact than more disease-specific instruments.[74] However, most of the 12 studies included in the current review using generic QoL questionnaires, such as the Pediatric QoL Inventory and World Health Organization QoL Scale, detected significant differences between children with and without ocular morbidity.

The current review has several strengths. First, we used a rigorous methodologic approach that followed a predefined, registered protocol. We developed a comprehensive search strategy not restricted by language and included studies across 14 countries. Further, we reduced heterogeneity by excluding parental proxy-reported QoL studies in the meta-analysis. Although this strategy might have excluded some well-designed studies, it strengthened the internal validity of the meta-analysis.

The results of the current review also should be interpreted in view of its limitations. First, most included studies were conducted in high-income or middle-income countries, with only 4 from low-income countries.[25,39,54,57] Additional evidence from low-income countries would contribute to a more comprehensive understanding of the association between vision impairment or ocular morbidity and QoL in children to inform policymaking. Second, all studies in the meta-analysis concerning the correction of strabismus used a before-and-after design without an untreated control group. As a result, we cannot rule out the possible role of placebo effects. However, because surgical correction of strabismus is the standard of care for many conditions, traditional trial designs with a control arm likely would be unethical. In future studies, researchers could use stepped-wedge designs, in which each participating cluster provides before-and-after observations and all participant groups receive surgery sequentially.[75] Third, our quality appraisal tools scored most of the included studies to be of low to moderate quality because of a variety of methodologic flaws, as outlined above and in the appendices. Heterogeneity in the dataset was high, as illustrated by the high I^2 statistics in all analyses. This could have arisen from variations in collecting information regarding various eye conditions (through self-report, medical records, or direct measurement by researchers). Fourth, most studies concerning myopia did not report information regarding the wearing of glasses among participants. As a result, we cannot separate those with and without glasses, making it difficult to interpret the various effects of myopia and glasses wearing on QoL. Fifth, most interventional studies provided only 1 to 3 months of follow-up after strabismus surgery, with the longest being 36 months.[47] Longer postoperative follow-up will deliver more accurate results because of the possibility of postoperative exotropia drift and the recurrence of intermittent exotropia.[76]

Our systematic review highlighted the finding that both myopia and strabismus are associated with lower QoL in children. Despite the availability of safe and low-cost

treatment for myopia, such as glasses, no RCT investigating the impact of its correction on QoL has been conducted. Although we assume that correction could improve QoL, glasses also could be uncomfortable and inconvenient during sports and other activities. Previous studies have demonstrated that being teased or bullied is a common barrier to wearing glasses.[77,78] Regardless, without evidence of its impact on QoL, we are unable to compare the usefulness of children's health interventions that could lead to effective advocacy for eye health resources to achieve Sustainable Development Goals (SDGs), particularly Sustainable Development Goal 3, which aims to enhance good health and well-being.[2] In addition, the QoL benefits of strabismus correction provide evidence of the importance of insurance coverage of strabismus surgery, especially in low-income and middle-income countries.

Footnotes and Disclosures

Originally received: July 7, 2023.
Final revision: August 16, 2023.
Accepted: September 5, 2023.
Available online: September 9, 2023. Manuscript no. OPHTHA-D-23-01241.

[1] Department of Ophthalmology, Sichuan Provincial People's Hospital, University of Electronic Science and Technology of China, Chengdu, China.

[2] Chinese Academy of Sciences Sichuan Translational Medicine Research Hospital, Chengdu, China.

[3] Centre for Public Health, Queen's University Belfast, Belfast, United Kingdom.

[4] Department Neurosciences, Psychology, Drug Research and Child Health (NEUROFARBA), University of Florence, Florence, Italy.

[5] Department of Ophthalmology, McGill University Health Centre, Montreal, Quebec, Canada.

[6] School of Medicine, Stanford University, Stanford, California.

[7] Orbis International, New York, New York.

[8] Department of Ophthalmology, University of Colorado School of Medicine, Aurora, Colorado.

[9] Affiliated Eye Hospital of Nanchang University, Nanchang City, China.

[10] Advanced Center for Eyecare Global, Bakersfield, California.

[11] Departments of Ophthalmology and Pediatrics, Duke University Medical Center, Durham, North Carolina.

[12] Shandong First Medical University (Shandong Academy of Medical Science), Jinan, China.

[13] Centre on China's Economy and Institutions, Stanford University, Stanford, California.

[14] Zhongshan Ophthalmic Centre, Sun Yat-sen University, Guangzhou City, China.

[15] Duke Global Health Institute, Duke University, Durham, North Carolina.

*Both authors contributed equally as first authors.

Disclosure(s):

All authors have completed and submitted the ICMJE disclosures form.

The author(s) have made the following disclosure(s): M.K.S.: Financial support − Stanford's Maternal Child Health Research Institute Department of Psychiatry and Behavioral Sciences, National Institute of Mental Health, National Institute of Aging, Patient Centered Outcomes Research Institute, Johnson & Johnson, Brain and Behavior Research Foundation; Advisory board − Sunovion, Skyland Trail; Consultant − Johnson & Johnson, Alkermes, Neumora, AbbVie, Karuna Therapeutics, Inc., Boehringer-Ingelheim; Honoraria − American Academy of Child and Adolescent Psychiatry; Royalties − American Psychiatric Association Publishing, Thrive Global.

N.W.: Financial support − Orbis International

D.H.C.: Financial support − Orbis International

H.N.: Financial support − Orbis International

N.C.: Financial support − Orbis International

Supported by Santen Pharmaceutical Co. and Orbis International. Santen Pharmaceutical has a partnership with Orbis International, which includes funding for specific research projects. Santen did not contribute to the study design, data extraction or analysis of this article, nor to the decision to submit for publication. Orbis International participated in the conceptualization, review design, protocol writing, study design, title and abstract screening, data extraction, and critical revision of the manuscript.

HUMAN SUBJECTS: No human subjects were included in this study. This is a systematic review and meta-analysis using de-identified participant data from all included studies. Informed consent was not obtained, and the Queen's University Belfast Ethics Committee agreed that approval was not required for this study. All research adhered to the tenets of the Declaration of Helsinki.

No animal subjects were included in this study.

Author Contributions:

Conception and design: Li, Chan, Virgili, Singh, She, Piyasena, Clarke, Patnaik, Cherwek, Prakalapakorn, Wang, Boswell, Congdon

Analysis and interpretation: Li, Chan, Virgili, Mavi, Pundir, Clarke, Huang, Congdon

Data collection: Li, Chan, Mavi, Pundir, Piyasena, Whitestone, Xiao, Negash, O'Connor, Huang

Obtained funding: Cherwek

Overall responsibility: Li, Chan, Virgili, Mavi, Pundir, Singh, She, Piyasena, Clarke, Whitestone, Patnaik, Xiao, Cherwek, Negash, O'Connor, Prakalapakorn, Wang, Boswell, Congdon

Abbreviations and Acronyms:
CI = confidence interval; **QoL** = quality of life; **RCT** = randomized controlled trial; **SMD** = standardized mean difference.

Keywords:
Childhood vision impairment, Myopia, Quality of life, Strabismus, Systematic review.

Correspondence:
Nathan Congdon, MD, MPH, School of Medicine, Dentistry and Biomedical Sciences, Institute of Clinical Science, Centre for Public Health, Royal Victoria Hospital, Queen's University, Belfast BT12 6BA, United Kingdom. E-mail: ncongdon1@gmail.com.

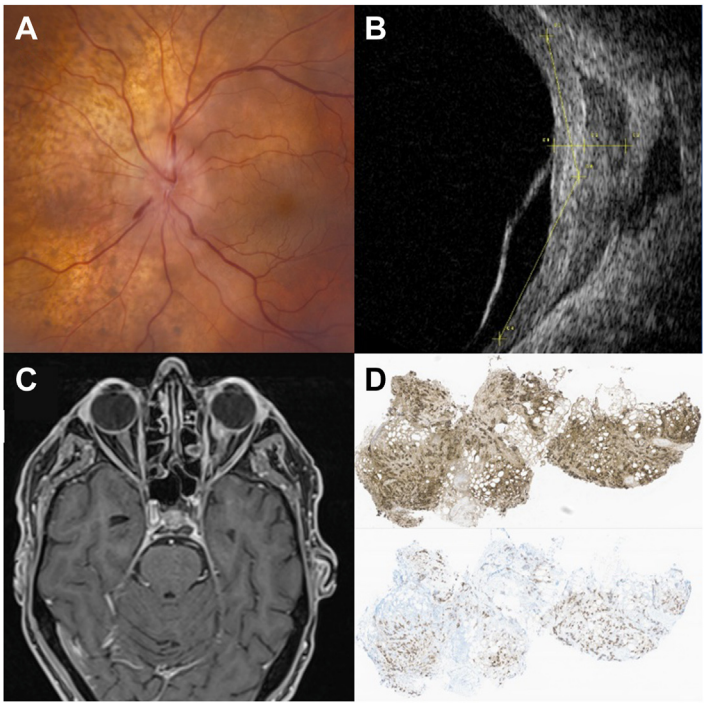
References

1. 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.
2. 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.
3. Gray C. Inclusion, impact and need: young children with a visual impairment. *Child Care Pract*. 2005;11(2): 179−190.
4. 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.
5. 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:g5740.
6. Chadha RK, Subramanian A. The effect of visual impairment on quality of life of children aged 3−16 years. *Br J Ophthalmol*. 2011;95(5):642−645.
7. Pan C-W, Wu R-K, Wang P, et al. Reduced vision, refractive errors and health-related quality of life among adolescents in rural China. *Clin Exp Optom*. 2018;101(6):758−763.
8. Elliott DB, Hurst MA, Weatherill J. Comparing clinical tests of visual function in cataract with the patient's perceived visual disability. *Eye (Lond)*. 1990;4(5):712−717.
9. Alexander MF, Maguire MG, Lietman TM, et al. Assessment of visual function in patients with age-related macular degeneration and low visual acuity. *Arch Ophthalmol*. 1988;106(11):1543−1547.
10. Cella DF. Quality of life: concepts and definition. *J Pain Symptom Manag*. 1994;9(3):186−192.
11. Rayat J, Almeida DR, Belliveau M, et al. Visual function and vision-related quality of life after macular hole surgery with short-duration, 3-day face-down positioning. *Can J Ophthalmol*. 2011;46(5):399−402.
12. Fallowfield L. What is quality of life. *Health Econ*. 2009, 1-8;1(8).
13. Assi L, Chamseddine F, Ibrahim P, et al. A global assessment of eye health and quality of life: a systematic review of systematic reviews. *JAMA Ophthalmol*. 2021;139(5): 526−541.
14. Lin S, Congdon N, Yam JC, et al. Alcohol use and positive screening results for depression and anxiety are highly prevalent among Chinese children with strabismus. *Am J Ophthalmol*. 2014;157(4):894−900.e1.
15. Fu J, Li SM, Liu LR, et al. Prevalence of amblyopia and strabismus in a population of 7th-grade junior high school students in Central China: the Anyang Childhood Eye Study (ACES). *Ophthalmic Epidemiol*. 2014;21(3):197−203.
16. Buffenn AN. The impact of strabismus on psychosocial health and quality of life: a systematic review. *Surv Ophthalmol*. 2021;66(6):1051−1064.
17. McBain HB, Au CK, Hancox J, et al. The impact of strabismus on quality of life in adults with and without diplopia: a systematic review. *Surv Ophthalmol*. 2014;59(2):185−191.
18. Wong HB, Machin D, Tan SB, et al. Visual impairment and its impact on health-related quality of life in adolescents. *Am J Ophthalmol*. 2009;147(3):505.
19. Wang Y, Wang H. Adverse influences of nonstrabismic amblyopia on quality of life of teenagers in China. *Comput Math Methods Med*. 2022:2621991.
20. Wen G, McKean-Cowdin R, Varma R, et al. General health-related quality of life in preschool children with strabismus or amblyopia. *Ophthalmology*. 2011;118(3):574−580.
21. Hsieh M-H, Lin J-C. Association of refractive error with vision-related quality of life in junior high school students. *Taiwan J Ophthalmol*. 2016;6(1):32−35.
22. Zhou KW. Effects of myopia on visual related life quality and mental health of senior high school freshmen, 545 *Chin J School Doctor*. 2019;33(7):490−491.
23. Bestilleiro Lopes MC, Salomao SR, Berezovsky A, Tartarella MB. Assessing vision-related quality of life in children with bilateral congenital cataracts. *Arq Brasil Oftalmol*. 2009;72(4):467−480.
24. Gu S, Hu Y, Zhao Y, et al. A retrospective study on the eye-related quality of life, functional vision, and their determinants among children following congenital and developmental cataracts surgery and its impact on their families using the PedEyeQ. *Front Public Health*. 2022;10:788384.
25. Habib F, Irshad E. Impact of visual impairment on quality of life among adolescents. *FWU J Soc Sci*. 2018;12(1): 149−155.
26. Kim H, Hyeon PJ, et al. The impact of refractive errors on quality of life in elementary school children. *J Korean Ophthalmol Soc*. 2010;15(2):175−183.
27. Leske DA, Hatt SR, Castaneda YS, et al. Eye-related quality of life and functional vision in children wearing glasses. *J AAPOS*. 2020;24(2):91.
28. Magakwe TS, Hansraj R, Xulu-Kasaba ZN. The impact of uncorrected refractive error and visual impairment on the quality of life amongst school-going children in Sekhukhune district (Limpopo), South Africa. *African Vis Eye Health*. 2022;81(1):7.
29. Qian DJ, Zhong H, Li J, et al. Spectacles utilization and its impact on health-related quality of life among rural Chinese adolescents. *Eye (Basingstoke)*. 2018;32(12):1879−1885.
30. Yamada T, Hatt SR, Leske DA, Holmes JM. Spectacle wear in children reduces parental health-related quality of life. *J AAPOS*. 2011;15(1):24−28.
31. Zhu Z, He Y, Yang J, et al., Study time, glasses utilization and age affect quality of life among senior first-year Chinese myopia students, *Eur J Ophthalmol*, 2021;31(6):2969-2976.
32. Wang D, Yang J, Xian Y, et al. Influencing factors on visual function-related life quality of myopic pupils in 4 primary schools in Urumqi. *Occup Environ Med*. 2019;35(12): 1697−1700.
33. Venâncio TS, de Araújo BMF, Negrão JVRdT, et al. The impact of monocular and binocular visual impairment on the quality of life of Brazilian children. *Br J Vis Impair*. 2022;40(2):463−471.
34. Wang WT, Wang HY, Qian YZ. Investigation on the quality of life of children with strabismus and amblyopia in Liuzhou City, 152 *Chin J Aesth Med*. 2020;29(11):21−23.
35. Schuster AK, Elflein HM, Pokora R, et al. Health-related quality of life and mental health in children and adolescents with strabismus—results of the representative population-based survey KiGGS. N.PAG-N.PAG *Health Qual Life Outcomes*. 2019;17(1):1-8.

36. Sim B, Yap GH, Chia A. Functional and psychosocial impact of strabismus on Singaporean children. *J AAPOS*. 2014;18(2):178−182.
37. Tu C, Ye L, Jiang L, et al. Impact of strabismus on the quality of life of Chinese Han teenagers. *Patient Prefer Adherence*. 2016;10:1021−1024.
38. Wang H, Qian J, Bian LZ. Influence of age, atrabisumic type and angle on the quality of life of children with intermittent exotropia. *Journal of Wannan Medical College*. 2021;40(2):183−185.
39. Merchant H, Murur T, De Sousa A, et al. A study on quality of life and self esteem in children and adolescents with strabismus. *Indian J Psychiatry*. 2019;6(3):290−293.
40. Song DS, Jia GZ, Qian J, et al. Evaluation of quality of life in intermittent exotropia by the Chinese version of the intermittent exotropia questionnaire. *Int Eye Sci*. 2022;22(9):1598−1602.
41. Silva N, Castro C, Caiado F, et al. Evaluation of functional vision and eye-related quality of life in children with strabismus. *Clin Ophthalmol*. 2022;16:803−813.
42. Zhang S-Y, Li J, Liu R, et al. Association of allergic conjunctivitis with health-related quality of life in children and their parents. *JAMA Ophthalmol*. 2021;139(8):830−837.
43. Archer SM, Musch DC, Wren PA, et al. Social and emotional impact of strabismus surgery on quality of life in children. *J AAPOS*. 2005;9(2):148−151.
44. Chai Y, Shao Y, Lin S, et al. Vision-related quality of life and emotional impact in children with strabismus: a prospective study. *J Int Med Res*. 2009;37(4):1108−1114.
45. Chew-Ean T, Ghani SA, Shatriah I. Infantile esotropia in Malaysian children: the impact of surgery on health-related quality of life assessment in patients and their parents. *Int Med J Malays*. 2020;75(5):531−537.
46. Cui CM, Lin S, Yue YY, Yan Y. The quality of life of children with intermittent exotropia after surgical correction: a one year follow-up. *Chinese Journal of Strabismus and Pediatric Ophthalmology*. 2020;28(2):20-23. .
47. Holmes JM, Hercinovic A, Melia BM, et al. Improvement in health-related quality of life following strabismus surgery for children with intermittent exotropia. *J AAPOS*. 2021;25(2):82.e1−e7.
48. Jiang LP, Yang X, Kong QL, et al. Short-term effect of surgery on the health-related quality of life in children with intermittent exotropia. *Int Eye Sci*. 2016;16(6):1128−1131.
49. Mao D, Lin J, Chen L, et al. Health-related quality of life and anxiety associated with childhood intermittent exotropia before and after surgical correction. *BMC Ophthalmol*. 2021;21(1):1−9.
50. Morita Y, Hiraoka T, Oshika T. Influence of intermittent exotropia surgery on general health-related quality of life: different perception by children and parents. *Jpn J Ophthalmol*. 2021;65:326−330.
51. Qian YZ, Wang WT, Chen QJ, Ning Q. The impact of strabismus surgery on children's quality of life. *Nursing Practice and Research*. 2021;18(21):3281−3284.
52. Wang X, Gao X, Xiao M, et al. Effectiveness of strabismus surgery on the health-related quality of life assessment of children with intermittent exotropia and their parents: a randomized clinical trial. *J AAPOS*. 2015;19(4):298−303.
53. Xiao H, Zhu H, Liu H. Evaluation of life quality of children with intermittent exotropia one year after the effective surgical treatment. *Chin J Ophthalmol*. 2019;55(1):31−36.
54. Ziaei H, Katibeh M, Mohammadi S, et al. The impact of congenital strabismus surgery on quality of life in children. *J Ophthalmic Vis Res*. 2016;11(2):188−192.
55. Deng Z, Luo Y. The effect of correction surgery in the improvement of visual function in 60 children with intermittent exotropia. *J Clin Med*. 2019;23(22):46−48.
56. Chen Y, Chen X, Chen J, et al. Longitudinal impact on quality of life for school-aged children with amblyopia treatment: perspective from children. *Curr Eye Res*. 2016;41(2):208−214.
57. Kavitha V, Heralgi MM, Parkar M, Harogoppa S. Quality of life in children with low vision following use of low vision aids. *Taiwan J Ophthalmol*. 2020;10(3):203−207.
58. Ye HH, Chen WR, Deng DM, et al. Quality of life assessment in children with congenital bilateral cataract. *Chin J Ophthalmol*. 2007;43(11):996−999.
59. Zhao F, Zhao G, Zhao Z. Investigation of the effect of orthokeratology lenses on quality of life and behaviors of children. *Eye Contact Lens*. 2018;44(5):335−338.
60. World Health Organization. Constitution of the World Health Organization. 2005. Available at: https://apps.who.int/gb/bd/PDF/bd47/EN/constitution-en.pdf?ua=1. Accessed 08.01.23.
61. 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):731−737.
62. Moreno MN, Morales Fernandez L, Ruiz Medrano M, et al. Quality of life and visual function in children with glaucoma in Spain. *Arch Soc Esp Oftalmol*. 2019;94(3):119−124.
63. Karaman S, Ozkan B, Gok M, et al. Effect of eye trauma on mental health and quality of life in children and adolescents. *Int Ophthalmol*. 2017;37(3):539−544.
64. AlDarrab A, Al Qurashi M, Al Thiabi S, et al. Functional visual ability and quality of life in children with glaucoma. *Am J Ophthalmol*. 2019;200:95−99.
65. Dahlmann-Noor A, Tailor V, Bunce C, et al. Quality of life and functional vision in children with glaucoma. *Ophthalmology*. 2017;124(7):1048−1055.
66. Ritchie A, Colapinto P, Jain S. The psychological impact of strabismus: does the angle really matter? *Strabismus*. 2013;21(4):203−208.
67. Johns HA, Manny RE, Fern KD, Hu YS. The effect of strabismus on a young child's selection of a playmate. *Ophthalmic Physiol Opt*. 2005;25(5):400−407.
68. Lim SB, Wong WL, Ho R, Wong I. Childhood intermittent exotropia from a different angle: does severity affect quality of life? *Br J Ophthalmol*. 2015;99(10):1405−1411.
69. Coats DK, Stager DR, Beauchamp GR, et al. Reasons for delay of surgical intervention in adult strabismus. *Arch Ophthalmol*. 2005;123(4):497−499.
70. Yang L, Min Y, Jia Z, et al. Medical expenditure for strabismus: a hospital-based retrospective survey. *Cost Eff Resour Alloc*. 2022;20(1):1−9.
71. Sathyan S, Jose J. Barriers responsible for delay in surgical correction of strabismus: a study among adults undergoing strabismus surgery at a tertiary care center in Kerala. *Kerala Journal of Ophthalmology*. 2017;29(2):102.
72. Anh TT, Dat DT, Minh HV. Identifying costs: the case of refractive error, strabismus, and ptosis amongst children in Vietnam. *Int J Healthc Manag*. 2021;14(4):1382−1388.

73. Eiser C, Morse R. Can parents rate their child's health-related quality of life? Results of a systematic review. *Qual Life Res*. 2001;10(4):347–357.
74. Wiebe S, Guyatt G, Weaver B, et al. Comparative responsiveness of generic and specific quality-of-life instruments. *J Clin Epidemiol*. 2003;56(1):52–60.
75. Hemming K, Haines TP, Chilton PJ, et al. The stepped wedge cluster randomised trial: rationale, design, analysis, and reporting. *BMJ*. 2015:350:h391.
76. Park H, Kim WJ, Kim MM. The stabilization of postoperative exo-drift in intermittent exotropia after surgical treatment. *Korean J Ophthalmol*. 2016;30(1):60–65.
77. Narayanan A, Kumar S, Ramani KK. Spectacle compliance among adolescents: a qualitative study from Southern India. *Optom Vis Sci*. 2017;94(5):582–587.
78. Kodjebacheva GD, Maliski S, Coleman AL. Use of eyeglasses among children in elementary school: perceptions, behaviors, and interventions discussed by parents, school nurses, and teachers during focus groups. *Am J Health Promot*. 2015;29(5):324–331.

Pictures & Perspectives



Esophageal Adenocarcinoma Metastatic to the Choroid with Extrascleral Extension

A 78-year-old man with history of esophageal adenocarcinoma, in remission 9 months after resection, chemotherapy, and radiation, presented with a peripapillary choroidal lesion with leopard-spot pigmentation and disc edema (**A**). Extraocular extension was demonstrated on B-scan and magnetic resonance imaging (**B**, **C**). A transconjunctival orbitotomy approach was performed rather than choroidal fine-needle biopsy to maximize tissue yield. Histopathology revealed expression of keratin (**D**), cytokeratin 20, caudal-related homeobox transcription factor 2 (CDX-2), and cytokeratin 7, consistent with metastatic esophageal adenocarcinoma. Positron emission tomography scan showed no primary tumor recurrence or additional metastases (Magnified version of Figure **A**-**D** is available online at www.aaojournal.org).

Haley S. D'Souza, MD[1]
Lauren A. Dalvin, MD[1]
Lilly H. Wagner, MD[1]

[1]*Mayo Clinic Department of Ophthalmology, Rochester, Minnesota*