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Review

Health-related quality of life measurements in children and adolescents with refractive errors: A scoping review

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ABSTRACT

Background: Refractive errors, particularly myopia, are the leading visual disorders worldwide, significantly affecting the quality of life (QOL) even after correction. This scoping review focuses on health-related quality of life (HRQOL) measurements for children and adolescents with refractive errors.

Main text: We explored generic and disease-specific HRQOL tools, examining their content, psychometric properties, and the impact of various interventions on QOL. Two English databases—PubMed, Embase, and one Chinese database, CNKI, were searched for relevant studies published from January 2001 to October 2023. Inclusion criteria encompassed studies using standardized instruments to assess the QOL of children aged 0–18 with refractive errors. The review compares prevalent HRQOL measurements, analyzes children's refractive error assessments, and discusses intervention effects on patient QOL.

Conclusions: The study underlines the necessity of developing disease-specific QOL instruments for very young children and serves as a practical guide for researchers in this field. The findings advocate for a targeted approach in HRQOL assessment among the pediatric population, identifying critical gaps in current methodologies.

1. Introduction

Refractive errors, which include conditions such as myopia, hyperopia, and astigmatism, can be quantified using diopters. For instance, a person with a measurement of −2.50 D has myopia, whereas a measurement of +2.50 D indicates hyperopia. The severity of myopia can be categorized based on its diopter measurement. Mild myopia ranges from −0.50 to −3.00 D, moderate myopia is between −3.00 and −6.00 D, and high myopia is anything greater than −6.00 D. High myopia in adolescents significantly increases the risk of associated ocular conditions such as retinal degeneration and detachment. The World Health Organization (WHO) identifies them as the second leading cause of visual impairment. Alarmingly, their prevalence is on the rise, particularly among children, with contemporary lifestyle changes, such as increased smartphone usage, being potential contributors.[1]

Studies indicate that over 35% of populations in various countries, including some developing nations, are affected by refractive errors.[2–4] Among children and adolescents aged 5 to 15, approximately 19 million face vision impairment, a staggering 67% of which can be attributed to uncorrected refractive errors.[5] While assessing the incidence rate of refractive errors is essential, understanding the severity of the associated conditions is equally vital. This is crucial for gauging the broader social impacts of these diseases.[6] Factors such as genetics and environment play pivotal roles in the prevalence of refractive errors, often interacting in

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complex ways.[7] Moreover, beyond clinical measures, it's indispensable to assess the quality of life to understand the holistic impact of the disease on patients.[8,9]

The development of myopia in children is a common phenomenon that occurs gradually from school age to adolescence. However, high myopia in adolescents significantly increases the risk of retinal degeneration, detachment, open-angle glaucoma, and cataract.[6] Recent research has shown that 10% of Asian high school students have high myopia, which can lead to retinopathy. In the United States, eye diseases cause a financial burden of $139 billion, with only $16 billion spent on correcting myopia.[5,7] Besides the economic burden, studies have shown that correcting low vision can significantly improve anxiety and depression indicators in patients with visual impairment, as well as negatively impact children's social integration and academic performance.[10]

The Patient Reported Outcome (PRO) is a health condition measurement obtained directly from the patient without instructions from clinicians or researchers.[8] Quality of Life (QOL) is defined by the World Health Organization (WHO) as an individual's perception of their status within the broader context of life, encompassing their goals, expectations, standards, and concerns. The method that is utilized to acquire this data is referred to as Patient Reported Outcome Measurement (PROM). PROMs can assess health-related quality of life, encompassing various dimensions, typically involving self-reported impacts on one's physical, emotional, and social well-being resulting from a medical condition or its treatment or to evaluate the state or perception of physical health.[8,11]

The lack of children's quality of life measurement is a major gap in the field of ophthalmology, despite the availability of children-specific measurements such as EQ-5D-Y and PedsQL age-specific scales. Refractive errors are the most common cause of blindness in school-age children, and there is a need to fill this gap and understand the quality of life of children with eye diseases.[12] Despite the glaring prevalence of refractive errors in children, there exists a noticeable gap in the field of ophthalmology concerning the measurement of children's quality of life. This study aims to identify and evaluate quality-of-life measurements for children with ametropia, assessing both their reliability and validity. Our findings will be pivotal for patients, their families, and healthcare professionals to holistically address the effects of eye diseases.

2. Methodology

The method employed for this scoping review was derived from the framework proposed by Arksey and O'Malley[13] and further refined based on the recommendations put forth by Levac et al. and Pham, M. T. et al..[14,15] To improve the quality and transparency of this scoping review, adherence to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines was ensured. The criteria for inclusion and exclusion, along with the databases to be utilized and the keywords for conducting the literature search, were meticulously established through thorough discussions and unanimous agreement among all contributing authors.[16]

2.1. Literature search

A comprehensive literature search was carried out in CNKI, PubMed, and Embase databases in October 2023 to locate pertinent studies. The search contained the following terms and their synonyms: "Refractive error", "myopia", "astigmatism", "ametropia", "hyperopia", "quality of life", "QoL", "Children", and "Adolescent".

The search approach was tailored to suit each database properly. We manually examined relevant reviews and included articles to find more qualifying studies. In addition, we thoroughly examined pertinent reviews and included articles to manually identify any other acceptable studies. We also searched the databases of the World Health Organization (WHO) to study books and unpublished works that fulfilled the requirements. The comprehensive search strategies are outlined in the Appendix.

2.2. Include and exclude results

2.2.1. Inclusion criteria

(1) Studies on children 's quality of life as research outcomes, including population-based longitudinal studies, cohort studies, case-control studies, cross-sectional studies, and randomized controlled trials; (2) participants were infants, children, or adolescents ≤18 years old; (3) using a standard scale to measure the quality of life.

2.2.2. Exclusion criteria

(1) Narrative comments, editorial papers, comments, letters, etc.; (2) no standard scale to evaluate the quality of life; (3) animal research; (4) participants were over 18 years old.

2.3. Selection process

By employing the search technique, we obtained a total of 1170 articles from the three databases as of October 14, 2023. Specifically, there were 790 articles in Pubmed, 215 articles in CNKI, and 165 articles in Embase. After the removal of duplication and ineligible articles by automatic tools, the identified records were screened by two independent reviewers (Wei Wu and Lisha Yi) in two stages (title and abstract screening, and full text). Conflicts were resolved by consensus and/or by consulting a third reviewer (Xiangjun Chen). In the first stage, individual assessments were applied to the remaining 852 articles, leading to the selection of 391 relevant research articles for this review. In the second stage, these articles underwent a comprehensive assessment, considering their inclusion in the study, adherence to screening criteria, and availability of full text. The evaluation of the remaining articles included specific criteria related to quality. Following a thorough team discussion, all authors reached a consensus on the selection of papers, resulting in a total of 62 out of 89 publications meeting the predefined requirements.

3. Results

Our meticulous exploration encompassed 62 scholarly articles, culminating in the identification of 16 quintessential quality-of-life instruments tailored for children with refractive errors. Of these, 11 are intricately aligned with ophthalmic conditions, while 5 cast a wider net, measuring generic aspects of life quality. Intriguingly, 47 studies predominantly leaned on ophthalmology-specific assessments, signaling a strong research preference and information bias, whereas 11 studies (constituting a notable 13%) embraced generic instruments. In addition, merely four have pioneered the development of quality-of-life assessments for children with refractive errors.

Among the revelations was the emergence of bespoke quality-of-life scales in four studies, a testament to the evolving landscape of pediatric refractive error research.[17–20] This pivot towards customization underscores an acute awareness of the nuanced impacts of refractive errors in young lives. Our synthesis, detailed in Tables 1, 2, 3 and 4, offers a panoramic view of these 16 assessments, tracing their utility in measuring children's refractive error-related quality of life.

Among these assessments, the NEI-VFQ-25 emerged as the most prevalently utilized instrument employed in 12 studies. This widespread application reflects its versatility in capturing the intricate impacts of vision impairments on the tapestry of daily life.[22] The PREP2, with its custom-tailored approach for the younger demographic, followed closely, featured in 10 studies.[43] The PedsQL, with its comprehensive sweep across physical, emotional, social, and academic dimensions, was utilized in 5 studies.[44–48] Similarly, the RSVP and the NEI-RQL-42 found application in 5 studies, shedding light on their unique perspectives in assessing vision-related quality of life.

Emerging assessments like the PREP2 and the PedEyeQ signal a new wave of age-specific assessments.[43,49,50] These assessments are carving

Table 1
Characteristics of the disease-specific measurement of quality of life for children with Refractive error.

Instrument	Applied diseases	Mode of Administration	Construct(domain, item)	Scoping algorithm	Record Period	Available Translation (the exact number is not clear, as new translations may be developed from time to time.)	N
National Eye Institute Refractive Error Quality of Life-42 (NEI-RQL- 42)[21]	myopia	self/proxy	The complicated NEI-RQL-42 refractive error-related quality of life (QoL) questionnaire has 13 subscales with 42 questions in 16 question/ response category forms. Clear vision 4. Expectations 2. Near vision 4. Far vision 5. Diurnal fluctuation 2. Limitations in activities 4. Glare 2. Symptoms 7. Correction dependence 4. Worry 2 Suboptimal correction 2. Appearance 3. Satisfaction with correction 1.	The NEI-RQL-42 measures 42 items in 13 domains, including near and distant visual acuity, glare, appearance, and correction satisfaction. Higher scores indicate greater quality of life. Each item was rescaled to 0 to 100 according to the user's manual, and the subscales were averaged to calculate a global score.	4 weeks	Spanish, Chinese, Japanese, Portuguese, Italian, and French,	5
(NEI-VFQ-25) 25-list-item National Eye Institute Visual Function Questionnaire[22]	myopia, astigmatism	self/proxy	It includes a single item each for general health and general vision assessment, two items for ocular pain, three items each for activities involving near and distance vision, and a vision-specific section that assesses social functioning (2 items), mental health (4 items), role difficulties (2 items), and dependency (3 items). Additionally, driving ability is evaluated through three items, while color and peripheral vision are each assessed with one item.	The NEI VFQ-25 subscale scores are the average of the list-items on a 0–100 scale, with 100 being the best score and 0 being the worst.	current	Spanish, French, German, Italian, Dutch, Chinese, Japanese, Korean, and Portuguese	12
(RSVP) The Refractive Status and Vision Profile[23]	refractive errors	self/proxy	The RSVP questionnaire has various domains, Function: This 12-item domain covers visual jobs and activities. This Driving Perceptions domain analyzes the individual's driving views and concerns with their current visual state using 3 items.Symptoms: This domain contains 13 items that address vision concerns like discomfort, light sensitivity, and blurred vision.Corrective Lens Issues: This domain has 13 entries about practical and comfort issues with corrective lenses.Expectations: Six measures assess user expectations for glasses or contacts and vision correction. Vision Preference: One item in this area lets people choose between distance and near vision. Satisfaction with Vision: Four items assess respondents' satisfaction with their vision under different settings.The Vision domain has three items.The general health domain has two item.	Questions have five possible responses, ranging from 1 to 5, with 5 representing the most common or serious issue. Therefore, larger scores indicate worse visual functioning on each subscale and the total score. The total score is the arithmetic mean of the four subscales, which are rescaled from 0 to 100.	1 month	Chinese, French, German, Italian, Portuguese, Spanish, and Turkish	5
Pediatric Refractive Error Profile2 (PREP2)[24]	refractive errors	self/proxy	The PREP2 questionnaire has seven domains. Handling Domain: This 8-item domain assesses vision corrective device application, maintenance, and practicality in various tasks.Overall Vision Domain: 8 items evaluate the vision correction's efficacy and clarity.Peer Perception Domain: This 8-item domain examines how peers view the individual's eyesight correction.Symptoms Domain: This 8-item domain addresses physical symptoms and discomfort following eyesight correction. The 8-item Appearance Domain measures the	Each statement has an answer of "strongly disagree", "disagree", "neutral", "agree", or "strongly agree", with raw ratings from 1 (negative) to 5 (positive). Subtracting one from the raw score and multiplying by 25 yielded final scores ranging from 0 (poor visual quality of life) to 100.	1 week	Spanish, Chinese, Turkish, Dutch, German, and Italian	11

(*continued on next page*)

Table 1 (*continued*)

Instrument	Applied diseases	Mode of Administration	Construct(domain, item)	Scoping algorithm	Record Period	Available Translation (the exact number is not clear, as new translations may be developed from time to time.)	N
			individual's self-perception and feelings about how they look with vision correction. Activities Domain: It comprises 8 elements and measures how vision correction affects sports and outdoor activities.Overall Domain: This final domain, with 7 items, represents broad attitudes and opinions concerning vision repair.Each domain captures a single vision correction component and has 56 pieces.				
Pediatric Eye Questionnaire (PedEyeQ).[25,26]	refractive errors	self/proxy	The PedEyeQ for children aged 5–11 has four categories with 10 items each, covering functional vision, eye-related discomfort, social issues, and frustration or worry. The PedEyeQ has four domains with 39 items for 12–17-year-olds. The PedEyeQ has 29 items in three domains: functional vision, eye-related discomfort, and social concerns for proxies of children aged 0–4. The 39- and 42-item PedEyeQ proxy for children aged 5–11 and teenagers aged 12–17 includes functional vision, eye-related discomfort and social, frustration/worry, and eye care. The Parent PedEyeQ has 35 items that examine the influence on the parent or family, the child's eye condition, self-image, social interactions, and visual abilities.	A linear transformation was used to convert scores, anchoring the Rasch range for each domain at 0 (worst) and 100 (best).	1 month	Spanish, French, German, Italian, Dutch, Turkish, and Chinese	4
the Student Refractive Error and Eyeglasses Questionnaire (SREEQ)[27]	refractive errors	self/proxy	A 38-item, Likert-scaled instrument was created, with two parts: Part A (15 statements) focuses on uncorrected vision perceptions, while Part B (23 statements) covers corrected vision perceptions and VRQoL with spectacle correction.	Each statement in Part A and Part B is to be rated based on the four-point scale provided at the bottom of the table. For Part A, the scale measures the frequency of vision problems without glasses ("All of the time", "Most of the time", "Some of the time", and "None of the time"). For Part B, the scale is about the perception with glasses and includes additional statements about quality of life ("Very much", "Somewhat", "A little bit", and "Not at all").	annually	only English	2
OrthoK and contact lens quality of life questionnaire OCL-QoL[28]	myopia	self/proxy	There are 23 different items assessed, covering various aspects related to vision and the use of optical devices. These range from satisfaction and quality of vision to specific situations such as driving, morning vision, and lighting conditions, as well as concerns like allergies, reading difficulties, costs, and potential complications.	The instrument utilizes an interval scale ranging from 0 to 100, where higher scores correspond to a superior quality of life.	today	English	1
Quality of Life Scale for Children with Visual Impairments (QOLS-CVI)[29]	myopia	self/proxy	QOLS-CVI domains include Physical, Emotional, Social, Role, Disability Common, and Visual Disability Specific. Questions are distributed as follows within these domains:Physical Function assesses Athletic Prowess with 3 items and Daily Functional Capacity with 5 items.Five items assess emotional health in the Emotional Function domain.The Social Function domain has 4 Communication Proficiency	The rating for each item is measured using a 5-point Likert scale, where respondents can choose from options ranging from "never" to "always". Each of the ratings for each item are then summed into an overall score, where higher scores are indicative of a superior quality of life.	2 weeks	Chinese, Spanish	1

(*continued on next page*)

Table 1 (*continued*)

Instrument	Applied diseases	Mode of Administration	Construct(domain, item)	Scoping algorithm	Record Period	Available Translation (the exact number is not clear, as new translations may be developed from time to time.)	N
			items and 2 Family Support items.Four items assess Role Function.Disability Common measures Optimistic Attitude with 3 items and Social Support Assessment with 6 items.Finally, the Visual Disability Specific domain covers a Module with 4 items and Influencing Factors and Satisfaction with 2.				
the LV Prasad-Functional Vision Questionnaire, LVP-FVQ)[30,31]	low vison	self/proxy	It was condensed to 19 items, each representing a question, with the aim of encompassing four specific areas: distance vision (consisting of six questions), near vision (consisting of six questions), color vision (consisting of two questions), and visual field (consisting of five questions).	A 5-point (0–4) scale was utilized for 19 items. Each question first asked for a "Yes" or "No" answer. If "No", the answer was recorded as "No difficulty", and the question score was zero. If yes, individuals were prompted to score each task's difficulty on a scale of 1–4. They were taught 1 signified "a little difficulty" and 4 meant "unable to do the activity due to visual reasons". All things were scored in the same direction and units.	2 months	Hindi, Arabic, English	2
CVFQ the children's visual function questionnaire[32,33]	refractive errors	self	The CVFQ has age-specific types for children under 3 years old (34 items) and children aged 3–7 years old (39 items).	Each questionnaire response ranged from 1 ("best") to 0 ("worst"). The average subscale item scores were Competence, Personality, Family Impact, and Treatment Difficulty. Thus, all subscale ratings ranged from 1 ("best") to 0 ("worst"), i.e., from most to least competent, pleasant and friendly personality, family influence, and treatment difficulty. All subscales were averaged for a Total Score.	1 month	Chinese, German, English	2
The Quality of Life Impact of Refractive Correction (QIRC)[34,35]	myopia	self/proxy	The study of the QIRC was to evaluate the influence of refractive correction on quality of life, whether achieved through the use of eyeglasses, contact lenses, or refractive surgery. The assessment is comprised of five distinct areas: visual function (1 Item), visual symptom (1 Item), visual convenience (5 Items), visual concern (6 Items), and emotional well-being (7 Items).	The 5-category scale (1–5) includes 'Not applicable'. 'Not applicable' or blank items are missing data and not used for QIRC scoring. Excel can score 'Not applicable' or missing data as '0'. Excel turns numeric data (0, 1, 2, 3, 4, 5) into 0–100 Rasch scaled QIRC scores. Patient scores entered on the 'Raw data' spreadsheet are automatically converted to 0–100 QIRC values on the 'Converted score' spreadsheet.	1 month	English, Malay, Greek, Dutch, Spanish and Chichewa	2

out niches in peer perception and visual functionality, indicating a shift towards more personalized and age-appropriate evaluations.

Our exploration further unearthed a diverse suite of specialized assessments, each offering a unique lens into the multifaceted nature of pediatric refractive errors. The NEI-VFQ-25 and RSVP provided comprehensive insights into the daily life impacts and overall visual function.[22,23,51–54] The PedEyeQ and the OCL-QoL offered detailed perspectives on specific age groups and treatment modalities.[28,49,50]

Additionally, assessments like the QOLS-CVI and the LVP-FVQ provided in-depth analyses of visual impairments in varied contexts.[29,55] The CVFQ and the QIRC questionnaire rounded out our findings, illuminating the broad implications of visual function and refractive corrections on quality of life.[32,34]

Each tool in this array brings its distinct strengths and specialized focuses, collectively enriching our comprehension of the impacts of refractive errors on children and adolescents. Their diverse methodologies underscore the complexity of this research area and highlight the need for a multifaceted toolkit to navigate the intricate interplay between vision, health, and quality of life.

4. Discussion

We have identified five generic quality-of-life measurement tools for assessing refractive error in children, described in a total of 11 articles. These tools were developed using Rasch analysis and employed traditional summary scores. All five tools provide comprehensive measures of both physical and mental health, but the SF-36 and EQ-5D-Y have additional domains for assessing general symptoms, such as pain.[56–58]

Table 2
Summarized main characteristics of the disease-specific measurement of quality of life for children with Refractive error.

Characteristics	Categories	Counts	Percentage
Applied diseases	low vision	1	8.33%
	myopia	4	33.33%
	myopia, astigmatism	1	8.33%
	refractive errors	6	50.00%
Mode of Administration	self/proxy	11	91.67%
	self	1	8.33%
Record Period	1 day	2	16.67%
	1 week	1	8.33%
	2 weeks	1	8.33%
	1 month	6	50.00%
	2 months	1	8.33%
	1 year	1	8.33%

4.1. Overview and comparison

The WHOQOL-BREF, PedsQL, and EQ-5D-Y are more applicable to children because of their short questions and easier comprehension by children, thus improving the accuracy of feedback and making the study more precise and, therefore, better able to study children's self-perceived quality of life.[44,46–48,59,60] Of the 11 quality-of-life tools for eye diseases, each has areas of concern about symptoms and impact on life, not limited to functional mind vision, distant strength, and near vision. The NEI-RQL-42, NEI-VFQ-25, and PREP2 are the most studied tools (accounting for 40% of the studies). NEI-RQL-42[61–65] and NEI-VFQ-25[66–77] are more inclined to evaluate functionality, making it suitable for obtaining primary symptoms and quality of life after surgery and treatment. The PREP2 specifically measures ametropia and includes a unique field to measure psychology, specifically peer perception. It is a suitable choice for researchers or clinicians who want to obtain more specific information about adolescent psychology.[43,62,78–85]

The RSVP measurement tool (n=5, 7%) is commonly used and biased towards assessing activity limitation and social functioning, such as driving and functional vision.[23,51–54] The PedEyeQ is specifically distributed according to age, with questions tailored for three age groups from 5 to 17 years old. This improves children's perception and provides more accurate feedback to researchers and clinicians about the patient's condition.[49,50,86,87] The CVFQ is also divided according to age and includes a quality of life test for children younger than 3 years old, which is essential for assessing quality of life in infancy and is a rarity in the measurement of children's quality of life.[32,33] It is important to note that the accuracy of CVFQ needs to be studied because it cannot demonstrate infant feelings from communication and words.

The SREEQ is a specific tool designed to measure the quality of life-related to refractive errors among students, focusing on those who wear glasses. This questionnaire is suitable for assessing the needs of students' eyes, and its questions are tailored towards students' experiences.[27,88] The OCL-QoL and PREP-OK are measurement tools for OrthoK and contact lenses, which are suitable for assessing the quality of life of individuals undergoing non-surgical treatments for refractive errors.[28,85] The QOLS-CVI and QIRC focus on measuring symptoms and psychological aspects related to visual impairments and refractive correction, respectively. Both of these tools can provide valuable insights into the patient's experience.[19,29,62] The LVP-FVQ is a specific questionnaire that measures functional vision, including color perception. In the intricate landscape of refractive error impacts, the judicious selection of a measurement tool, each with its distinct lens on the multifaceted aspects of quality of life, is crucial. It ensures that our exploration and intervention strategies are finely tuned to the specific dimensions and experiences of those affected, thereby advancing our collective understanding and management of visual impairment.[55,89]

4.2. Developed quality of life measurement tools

Out of 62 studies screened, only four have developed quality of life tools for children with refractive errors, which were developed in China, Australia, the United States, and Poland. The vision-related quality of life scale for primary and secondary school students in China consists of 22 items that reflect the physical and psychological characteristics of children with visual impairment.[90] The Australian table uses a numerical scale in the questionnaire that corresponds to emoticons or visual images, making it more suitable for children, and utilizes specific visual performance to aid in comprehension.[17] Poland developed a self-made questionnaire with eight questions, divided into two sections to assess the impact of visual function and self-esteem, respectively, with a score of 1–10 points for each question.[18] The research and development in the United States includes two questionnaires for children and parents, with 36 questions focused on appearance, coordination, glasses, and learning for children, and 61 questions about help, school issues, costs, and impact on work for parents, providing a more comprehensive understanding of a family's quality of life, particularly on the financial burden. These developments demonstrate a new focus in the quality of life research and development process in recent years.[18]

4.3. Strengths and limitations

This review has systematically examined literature pertaining to tools that measure the quality of life in children with ametropia. We found a significant emphasis on school-aged children, particularly within junior and senior high school demographics, while younger children are notably underrepresented in available tools. We also identified various generic health-related quality of life (HRQOL) measurement tools and discussed their applicability and limitations in assessing refractive errors in children. While instruments like SF-36 and EQ-5D-Y offer broad insights, disease-specific tools such as NEI-RQL-42 and NEI-VFQ-25 focus on vision functionality, and the PREP2 emphasizes adolescent psychology and peer perception. This diversity in tools underscores the need for a multifaceted approach to HRQOL measurement, accommodating the unique perspectives and challenges of assessing young populations.

Our literature review, spanning from January 2001 to October 2023, was designed to capture recent advancements and trends relevant to contemporary research and practice. By focusing on this timeframe, we aimed to ensure the relevance of our findings to current discussions in the field. However, this choice inherently excluded seminal works before 2001, potentially overlooking foundational research pivotal to the development of this field. While our approach prioritizes current applicability, it also introduces a limitation in historical depth, suggesting that future reviews could benefit from a broader temporal scope to fully appreciate the field's evolution and its impacts on current methodologies and trends. Our review did not extensively cover geographical connections, indicating a need for further research into regional associations and lifestyle habits. The article presents four new quality-of-life scales developed independently by different countries, which do not represent any specific regional issues. This highlights a gap in our understanding of how regional and cultural differences may influence quality of life in the context of refractive errors, suggesting an area ripe for future inquiry. Focusing on orthokeratology, we explored its impact from the patient's perspective using the OrthoK and contact lens quality of life questionnaire (OCL-QoL). The initial pilot questionnaire comprised 45 items, which were refined to 23 items after psychometric assessment, emphasizing symptom-based inquiries. This refinement process underscores the importance of evaluating interventions not only for their clinical outcomes but also for their impact on patient's quality of life. Although our study included atropine interventions, it lacked a dedicated measurement tool for such treatments. It highlights a future research opportunity to develop and evaluate quality-of-life measurement tools for a broader

Table 3
Characteristics of the generic measurement of quality of life for children with Refractive error.

Instrument	Applied diseases	Mode of Administration	Construct(domain, item)	Scoping algorithm	Record Period	Available Translation	N
The Medical Outcomes Study 36-Item Short Form[36,37]	myopia	self/proxy	The SF-36 questionnaire comprises eight multi-item subscales that assess physical function, social functioning, role constraints caused by physical difficulties, role restrictions caused by emotional problems, mental health, vitality, pain, and general perception of health.The Physical Functioning (PF) domain consists of 10 items. The Role Physical (RP) domain includes 4 items. The Bodily Pain (BP) domain includes 2 items. The General Health (GH) and Vitality (VT) domains each consist of 5 items. The Social Functioning (SF) domain includes 2 items. The Role Emotional (RE) domain includes 3 items. The Mental Health (MH) domain consists of 5 items. Lastly, the Health Transition (HT) domain includes 1 item.	Scale scores are produced by averaging responses across items and converting them to a 0–100 scale.Higher scores indicate greater health.Before calculating the raw Physical Component Summary (PCS) and Mental Component Summary (MCS) scores, some items were recoded and scale scores were changed from 0 (worst) to 100 (best). Standard scores were calculated from raw PCS and MCS scores using normalized algorithms from the US general population, with a mean value of 50 and a standard deviation of 10.	4 weeks	The SF-36 has been translated and adapted in 29 countries	1
GQOL-74Generic Quality of Life Inventory-74 (GQOLI-74),The QOL was measured by the generic quality of life inventory-74 (GQOLI-74). (The GQOLI-74 is a Chinese version of the WHOQOL-100.)[38]	myopia	self/proxy	The 4D structure consists of bodily function, mental function, social function, and material life conditions. It encompasses a total of 20 elements and 74 items.	The GQOLI-74 assessment includes a material life score that can vary from 16 to 80 points, as well as social, physical, and psychological function scores that can range from 20 to 100 points. The final score was 76–380 points, with higher values suggesting a superior quality of life.	1 week	Chinese	1
World Health Organization Quality-of-Life Scale (WHOQOL-BREF)[39]	myopia	self/proxy	It is a concise questionnaire of 26 items that assess four distinct domains: physical health (consisting of 7 items), psychological health (consisting of 6 items), social relationships (consisting of 3 items), and environmental health (consisting of 8 items). Additionally, it includes items that measure overall quality of life and general health.	Experience determines each question's score, which goes from 1 to 5 ('not at all' to 'an enormous amount' or 'completely'). Negative questions 3, 4, and 26 flip the score. A 1 becomes a 5, a 2 becomes a 4, a 3 stays a 3, a 4 becomes a 2, and a 5 becomes 1. Reverse Q3, Q4, and Q26 and add the questions' scores in each domain, then divide by the number of questions in that domain to produce an average. For the Physical domain, add Q3 and Q4's inverted scores to Q10, Q15, Q16, Q17, and Q18, then divide by 7 (there are 7 questions). For psychological domain, add Q5, Q6, Q7, Q11, Q19, and inverted Q26, then divide by 6.Add Q20, Q21, and Q22 to Social Relationships and divide by 3.For Environment, add Q8 to Q14 and Q23 to Q25, then divide by 8.Multiply domain average scores by 4. Domain ratings range from 4 to 20.Domain life quality improves with higher ratings. A score near 20 suggests greater life quality. In that domain, a score near 4 suggests lower quality of life.	4 weeks	The WHOQOL-BREF has been translated and adapted in 77 language	2
Pediatric Quality of Life Inventory (PedsQL[40])	refractive error	self/proxy	The assessment includes 8 items related to physical functioning, 5 items related to emotional functioning, 5 items related to social functioning, and 5 things related to school functioning.	To enhance interpretability, the items are subjected to reverse scoring and linear transformation, resulting in a scale ranging from 0 to 100. This allows greater scores to reflect a higher level of Health-Related Quality of Life (HRQOL). To	1 month	The PedsQL has been translated and adapted in 93 countries	5

(*continued on next page*)

Table 3 (*continued*)

Instrument	Applied diseases	Mode of Administration	Construct(domain, item)	Scoping algorithm	Record Period	Available Translation	N
				reverse the scoring, convert the items on the 0–4 scale to a 0–100 scale using the following transformation: 0 becomes 100, 1 becomes 75, 2 becomes 50, 3 becomes 25, and 4 becomes 0. to 0–100 as follows: 0 = 100, 1 = 75, 2 = 50, 3 = 25, 4 = 0.			
EQ- 5D-Y[41,42]	myopia	self/proxy	The five dimensions include mobility, self-care, usual activities, pain/discomfort, and anxiety/ depression. A modified version of the EQ-5D questionnaire, called the EQ-5D-Y (Youth), designed for younger individuals to self-report their health status.The descriptive system consists of five dimensions: mobility, self-care, typical activities, pain or discomfort, and emotional well-being.	Discrete choice experiment (DCE) data are used to model the relative importance of five health dimensions, while composite time trade-of (cTTO) data anchor the results onto the QALY scale per protocol. Many nations have released value sets.	today	The EQ-5D-Y has been translated and adapted in English Spanish Chinese and Japanese	2

Table 4
Summarized characteristics of the generic measurement of quality of life for children with Refractive error.

Characteristics	Categories	Counts	Percentage
Applied diseases	myopia	4	80.00%
	refractive errors	1	20.00%
Mode of Administration	self/proxy	5	100.00%
Record Period	1 day	2	33.30%
	1 week	1	16.70%
	1 month	3	50.00%

range of interventions, including atropine eye drops and outdoor activities. Furthermore, the research compiled predominantly consists of observational studies, which, while informative, offer a constrained insight into the full impact of the diverse quality-of-life assessment tools. Future research endeavors should pivot towards intervention-based studies to yield a more comprehensive understanding and to elucidate the potential effects and applications of these instruments in clinical practice.

4.4. Future research directions

Our comprehensive review of 62 scholarly articles has illuminated the rich landscape of quality-of-life (QoL) assessment tools in the context of pediatric refractive errors. Despite the advancements in this field, our analysis has identified critical gaps that must be addressed to enhance our understanding and improve outcomes for children with refractive errors.

Utility Measurement and Applicability: Our findings reveal a significant gap in the utility measurement of existing QoL tools, both generic and disease-specific. This gap underscores a pressing need to evaluate the practicality and relevance of these tools across diverse clinical and research settings. Accurate utility measurement is crucial for ensuring that these instruments meet the nuanced needs of different contexts, thereby enhancing the precision and applicability of pediatric refractive error management.

Development of Age-Specific Tools: Another notable gap is the lack of QoL assessment tools specifically designed for younger children with ametropia. Given the unique developmental, psychological, and social challenges this demographic faces, it is imperative to develop tailored instruments that accurately reflect their specific experiences and needs.

Building on these foundational gaps, we propose several targeted research directions to deepen our understanding and improve the quality of life for children with refractive errors. 1). Longitudinal and Developmental Studies: There is an urgent need for longitudinal studies that trace the impact of refractive errors and their treatments over time, from early childhood through adolescence. Such research can provide valuable insights into the evolving nature of these conditions and their long-term effects on children's quality of life. 2). Cultural Sensitivity and Global Applicability: Future research should also prioritize the cultural adaptation and validation of QoL instruments. This focus will ensure the global applicability of these tools, making them relevant and effective across diverse populations. 3). Technological Innovations: The potential of digital health technologies and telemedicine in revolutionizing QoL assessment cannot be overstated. Future studies should explore these technologies to enhance real-time data collection and patient engagement. 4). Focused Intervention Studies: Detailed investigations into the outcomes of various refractive error treatments, including surgical, non-surgical, and pharmacological interventions, are essential. These studies will help identify the most effective strategies for improving the quality of life for affected children. 5). Health Economics and Policy Implications: Incorporating health economic analyses and developing standardized outcome sets for ametropia interventions will facilitate cross-study comparisons and inform practice guidelines and health policy decisions.

5. Conclusions

In summary, while we have a foundational understanding of tools available for measuring quality of life in children with ametropia, there's a pressing need to refine these instruments, ensuring they cater to all age groups and provide actionable insights for clinicians and researchers.

Study approval

Not applicable.

Author contributions

Conceptualization: LY and WW; methodology: LY; software: WW; validation: LY, KZ, and CS; formal analysis: KZ; investigation: CS; resources: CC; data curation: WW; writing—original draft preparation: LY; writing—review and editing: ZC and CC; visualization: LY; supervision: LH and XC; project administration: YC; funding acquisition: LH and XC. All authors have read and agreed to the published version of the manuscript.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.aopr.2024.03.001.

Abbreviations

CVFQ	Children's Visual Function Questionnaire
GQOLI-74	Quality of Life Inventory-74
HRQOL	health-related quality of life
LVP-FVQ	LV Prasad-Functional Vision Questionnaire
NEI-RQL-42	NEI Refractive Quality of Life-42
NEI-VFQ-25	National Eye Institute Visual Function Questionnaire
OCL-QoL	Orthokeratology and Contact Lens Quality of Life Questionnaire
PedEyeQ	Pediatric Eye Questionnaire
PedsQL	Pediatric Quality of Life Inventory
PREP2	Pediatric Refractive Error Profile2
PRISMA	The Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PRO	Patient Reported Outcome
PROM	Patient Reported Outcome Measurement
QIRC	Quality of Life Impact of Refractive Correction
QOL	Quality of life
QOLS-CVI	Quality of Life Scale for Children with Visual Impairments
RSVP	Refractive Status and Vision Profile
SREEQ	Student Refractive Error and Eyeglasses Questionnaire
WHO	World Health Organization
WHOQOL	World Health Organization Quality-of-Life

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