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ORIGINAL ARTICLE

Investigation of current guidelines for prescribing spectacles to children using a modified Delphi approach and the AGREE II tool

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Abstract

Purpose: This study aimed to identify clinical guidelines that provide recommendations on prescribing refractive error correction in children, evaluate the overall quality of these guidelines using the Appraisal of Guidelines for REsearch and Evaluation II (AGREE II) tool and subsequently gain consensus on the prescribing recommendations from high-quality guidelines using the modified Delphi technique.

Methods: A comprehensive search for prescribing guidelines was conducted using databases and professional websites. The quality appraisal of eligible guidelines was undertaken by scoring the six AGREE II domains. Subsequently, the modified Delphi technique was used by 10 experts (sub-specialist optometrists, ophthalmologists and orthoptists) to gain consensus on the prescribing recommendation statements extracted from guidelines that had been identified as high quality. Three rounds were conducted in which agreement of these statements were scored using a 9-point Likert scale with a free-text option for any additional comments.

Results: Five eligible guidelines were identified. The AGREE II tool demonstrated that the guidelines varied substantially in quality, with only one guideline identified as being of high quality. A total of 168 prescribing statements were reviewed in the Delphi procedure. Of these, 95 statements reached expert consensus as being appropriate prescribing recommendations.

Conclusion: There is significant scope for improving current guidelines for prescribing refractive error correction in children. We used the modified Delphi technique to find points of agreement on prescribing recommendations to support professionals prescribing refractive error correction in children. We recommend that further work is needed to address gaps in the guidelines.

KEYWORDS
AGREE II, child, clinical guidelines, Delphi technique, refractive prescribing

INTRODUCTION

Refractive error in children may be of a magnitude that warrants correction or may require monitoring.[1] While there can be a wide range of refractive errors at birth, the average cycloplegic mean spherical equivalent is +2.20 dioptres (D) ±1.60 D (mean ± standard deviation) at 1 month,[2] reducing to around zero by early childhood due to emmetropisation.[3–6] Studies on school-aged children have shown that uncorrected refractive error

is one of the most common causes of visual impairment in children.[7] High refractive errors or those such as anisometropia (interocular difference in refractive error[8,9]) or astigmatism in early childhood are causes of amblyopia, a condition in which visual acuity is reduced, and which may be treatable in early childhood[10] but is not easily treated in young or older adults.[11] However, when there is anisometropia of ≥3.00 DS, there is a significant chance of the child developing amblyopia.[12] The relationship between refractive error and horizontal strabismus in children and adults has also been explored and esodeviations have been associated with hyperopia.[13] Appropriate spectacle prescribing in children to correct associated strabismus, improve visual acuity and prevent amblyopia is therefore of great importance as this can impact their visual development[14] and to minimise potential negative impacts on academic performance.[15,16]

Optometrists working in primary and secondary settings in the United Kingdom, and some paediatric ophthalmologists, prescribe refractive error corrections in children. There are however variations in practice within and outside the profession,[17,18] and it has been noted that community-based optometrists have a lower threshold for prescribing spectacles compared to hospital optometrists.[19] There is also variability in the approach to prescribing for manifest or latent strabismic or amblyopic children[20] and in the level of refractive error at which UK hospital optometrists would consider prescribing spectacles to non-strabismic children.[20] Variations in prescribing patterns among eye care practitioners may be influenced by differing training programmes and their clinical experience.[21,22] In a study of prescribing patterns of UK optometrists, it has been reported that habits vary, from prescribing the full refractive error finding to partially prescribing the refractive error to aid adaptation and spectacle acceptance.[23] As well as the level of refractive error, additional factors that need to be considered in prescribing include the child's age, family ocular history and the presence of manifest strabismus or amblyopia.[24]

The UK National Institute for Health Care Excellence (NICE)[25] defines a clinical guideline as 'Evidence-based recommendations on a topic including preventing and managing specific conditions, improving health, and managing medicines in different settings'; while the World Health Organisation (WHO)[26] defines a clinical guideline as 'A document containing recommendations about health interventions, whether these are clinical, public health or policy recommendations'. Clinical guidelines help guide healthcare professionals in evidence-based practice, reduce clinical practice variation[27] and improve the quality and resources of health care.[28–31] In addition, there is evidence to suggest that healthcare practitioners who use guidelines have a better understanding of the condition and treatment than those who do not use them.[32,33] In the context of refractive error and prescribing, guidelines might be helpful when optometrists are considering prescribing refractive correction in very young children. For example, in 2011, Leat[34] published prescribing guidelines for optometrists based on the available research evidence. The Royal College of Ophthalmologists[35] and the American Academy of Ophthalmology[36,37] have guidelines based on available evidence as interpreted by a panel of knowledgeable health professionals. However, these guidelines have not been evaluated to date, so their quality is untested.

Key points

- Variations exist in how refractive error correction is prescribed in children. Habits vary, from fully to partially correcting refractive error, the latter to aid adaption and spectacle acceptance.
- We used a validated tool to appraise existing guidelines on refractive prescribing for children and found that the quality of these was variable with only one graded as high quality.
- Further research is required to build good quality, reliable evidence-based guidelines to support eye care professionals' clinical decision making when prescribing refractive error correction in children.

This study aimed to identify high-quality clinical guidelines that provide recommendations on prescribing refractive error correction in children (12 years of age and under) and evaluate the overall quality of these guidelines using the Appraisal of Guidelines for REsearch and Evaluation II (AGREE II) tool. The AGREE II focuses on the guideline's methodological aspects, not clinical appropriateness.[38] Therefore, a subsequent Delphi study was conducted to establish expert consensus on prescribing recommendations that are clinically appropriate,[39] meaning applicable in a clinical situation. Clinically appropriate recommendations are dependent on the patient's signs and symptoms, are likely to be acceptable to patients and their parents/carers and are therefore likely to have good adherence.

METHODS

Ethical approval was obtained from the Optometry Research and Ethics Committee at City, University of London. Written informed consent was obtained from all participants, conforming to the tenets of the Declaration of Helsinki.

A literature search was conducted using research platforms OVID, EBSCOhost and Google Scholar in addition to the NICE database and professional websites (College of Optometrists, Royal College of Ophthalmologists and the American Academy of Ophthalmology) to find the available guidelines for prescribing refractive correction in children. The eligibility criteria were as follows:

1. Included a clear recommendation specific to paediatric prescribing.
2. No date restriction (time period).
3. Sample includes children.
4. No geographical restriction to the guidelines.
5. Published in English.
6. No restriction to specific eye care profession (could be aimed at prescribing by any eye care provider involved in decisions about refractive prescribing, including optometrists, ophthalmologists and orthoptists).

The search was based on keywords (Appendix 1) relating to paediatrics, prescribing and refractive error. As indicated earlier, the search was not restricted by date of publication. The reference list of each publication was reviewed to further the search. Two researchers (SW and CS) independently screened all guidelines found, to establish which met the earlier criteria. In the event of disagreement, consensus was reached by discussion. The PRISMA guidelines (Appendix 2) were followed during the search of the guidelines and their appraisal (described next).

AGREE II tool

There are 40 appraisal tools available for guideline quality appraisal, 38 of which are published in English.[40] The tools differ in the criteria used (e.g., number of domains, rating scale, number of appraisers required). Previous research has indicated that the AGREE II is the most robust tool in terms of its characteristics and domains compared to others,[41–45] and has undergone testing to ensure validity and reliability,[46,47] making it appropriate for use in this study.

The AGREE II tool focuses on the methodological aspects of a guideline's development. It does not evaluate its clinical appropriateness.[46] Therefore, after assessing the guidelines, a Delphi study (described next) was conducted to gain expert consensus on their clinical appropriateness.

The AGREE II has 23 items which are grouped into the following six domains: scope and purpose, stakeholder involvement, rigour and development, clarity of presentation, applicability and editorial independence.[38] Two researchers (SW and IC) critically appraised the clinical guidelines using the AGREE PLUS platform, scoring each domain and assessing the correlation between their appraisal results.[48] During the appraisal, the 23 items on the AGREE II tool were rated on a scale of 1 (lowest quality/strongly disagree) to 7 (highest quality/strongly agree).[47] Based on the guidance, if an item did not apply to the guideline being appraised, it would be scored as 1, meaning information is absent and, therefore, of low quality in the present context. The domain scores were calculated from the scores for each item within the domain and are a percentage score based on the following formula:[48]

$$\text{Domain score} = (\text{Obtained score} - \text{Minimum possible score}) / (\text{Maximum possible score} - \text{Minimum possible score}) \times 100$$

$$\text{Minimum possible score} = 1\ (\text{strongly disagree}) \times (\text{number of items}) \times (\text{number of appraisers})$$

$$\text{Maximum possible score} = 7\ (\text{strongly agree}) \times (\text{number of items}) \times (\text{number of appraisers})$$

Descriptive statistical analyses were conducted, and agreement between appraisers for each domain was assessed using two-way, mixed, absolute agreement intraclass correlation coefficients (ICC). The criterion level of ICC indicating moderate agreement is 0.5–0.6.[49,50] If the score for an item differed by three or more points or the ICC value was ≤0.50, the appraisers discussed the item to reach consensus.[51,52] If the two appraisers could not agree, a third party would be consulted to reach consensus[53,54] though this was not necessary.

The AGREE II tool does not give a domain score for the overall quality of the guideline. Therefore, as well as assessing correlation between appraisers for each domain, the appraisers noted whether they considered the guideline to be of high, medium or low quality based on the domain scores and their overall judgement. Previous literature suggests that a score of 60% or more on at least four of the six domains, including the domain 'rigour of development' indicates high quality.[54,55] The threshold for 'rigour of development' (domain three) was 70%, as recommended by the AGREE II manual.[48] In the event of disagreement on overall quality, consensus was reached by discussion.

Delphi study

The Delphi technique[39] was used to gain expert consensus after considering alternative approaches, such as Nominal Group Technique and focus groups. There are over 20 variations of the Delphi technique[55] that anonymously evaluate individual opinions and outcomes that aid the decision-making process instead of producing definitive recommendations.[56,57] A web-based format was used enabling inclusion of geographically and otherwise diverse participants.[58,59]

In this study, a three-round modified Delphi approach was used to gain expert consensus on prescribing recommendation statements for managing children with refractive error. This approach has been used previously to develop competencies and specifications within the eye care professions[60–63] and in various medical areas.[64,65] It was deemed to be appropriate in obtaining maximum engagement with the participants without unnecessarily lengthening the technique. Statements were extracted from high-quality prescribing guidelines, as identified by the AGREE II tool (described earlier). Only one guideline was identified as high quality and subsequently used for the Delphi study.

A questionnaire was created for the Delphi study using Qualtrics (an online tool, https://www.qualtrics.com/uk/). Prescribing recommendation statements were extracted

from this high-quality guideline to create a pilot questionnaire, which also included a section on demographic information. The extracted prescribing statements typically included a level of refractive error and whether a modified or full correction should be prescribed. If the latter was not specified in the guidelines, this was indicated in the questionnaire.

A pilot study was undertaken prior to the main Delphi procedure with a small sample of three clinicians (two optometrists and one orthoptist who were not part of the main Delphi study) to identify any areas of the questionnaire in need of refinement. Following consent, the clinicians were emailed a link to the online questionnaire and given 4 weeks to complete their responses. The pilot consisted of a single round in which the clinicians only had one questionnaire to complete. On completion, they were asked for feedback on the approach, including the framing of questions. The clinicians scored each statement in the questionnaire from 1 to 9 (1 = strongly disagree, 9 = strongly agree), indicating their level of agreement. There was an additional box whereby they could justify their answers or comment on other clinical information needed to make a prescribing decision. The feedback was considered and addressed as appropriate (e.g., no changes made to dioptric values for ametropia derived directly from the guidelines), and a revised version of the questionnaire was used in the main study.

The main Delphi study comprised a panel of 10 practising and registered clinicians, including two paediatric subspecialist ophthalmologists, six optometrists specialising in paediatric eye care working in hospital and community practice and two orthoptists. The participants were chosen using a combination of purposive and convenience sampling techniques. To ensure confidentiality, each participant was given a code to track their responses through the different Delphi rounds to enable feedback.

In each round, panel members individually scored their agreement with each prescribing statement on a nine-point scale (1 = strongly disagree, 9 = strongly agree). Correlation criteria for consensus were calculated to determine which prescribing statements reached consensus and which did not. Only statements that did not reach consensus were through to the next round. The median agreement scores and interquartile range (IQR) was calculated for each statement. If ≥60% of the panel members scored a prescribing recommendation of ≥6, the statement was deemed by consensus to be clinically appropriate. If a median score of <6 was obtained by ≥60%, the statement was deemed inappropriate. Of note, while some previous studies have used the 'mean score' of 66%, mean values are likely to be skewed by extreme scores.[60,66] Therefore, due to the sample size in this study, the median scores and their IQRs were considered more appropriate to ensure the level of agreement between panel members.[67,68]

In Round 1, panel members were sent instructions on how to access and complete the questionnaire. In the next round, each panel member received a revised Round 2 questionnaire including statements that had not reached consensus in the previous round and incorporating anonymised responses from all panel members, as well as each statement's median score from panel members in Round 1. The panel members were invited to consider their previous judgement on each prescribing statement in the context of those from other participants in Round 1. In the third round, each panel member received a revised Round 3 questionnaire including statements that had not reached consensus in the previous round, incorporating individual anonymised responses from all panel members, and median scores from Round 2. Again, the panel members were invited to consider their previous judgement on each prescribing statement in the context of those made by other participants in the previous round.

Participant withdrawal during the study was minimised by following up with non-respondents, giving prompt feedback to prevent fatigue and not lengthening the study unnecessarily. Demographic data were analysed to observe any patterns in responses during and between the Delphi rounds and response reliability was quantified using Cronbach's alpha (α).

RESULTS

Search results

The literature search conducted in November 2019 yielded 65 records, including resources identified from reference lists of relevant primary research studies. Reviewers (SW and CS) agreed on most of the records, and any discrepancy was resolved by discussion. Seventeen resources met the inclusion criteria, of which only five met the definition of a guideline. Details of the assessment of articles for eligibility, along with the reasons for excluding full-text articles and resources, are shown in the PRISMA diagram[69] (Figure 1). The five guidelines that met the inclusion criteria underwent a methodological quality appraisal using the AGREE II tool[48] (Table 1).

Only one guideline, the Pediatric Eye Evaluations Preferred Practice Pattern® (American Academy of Ophthalmology)[36] was identified as being of high quality, with an agreement ICC of 0.957 ($p < 0.05$) (Table 1). Therefore, this was the only guideline that was included in the Delphi study.

Delphi study

The pilot questionnaire used in the Delphi study consisted of 68 prescribing statements extracted directly from the high-quality guideline identified using the AGREE II tool. The pilot study feedback identified the need to consistently specify age ranges, level of vision and whether any astigmatism referred to was oblique or not oblique for each prescribing statement. The pilot questionnaire was amended resulting in 168 statements for review in Round 1 of the main study.

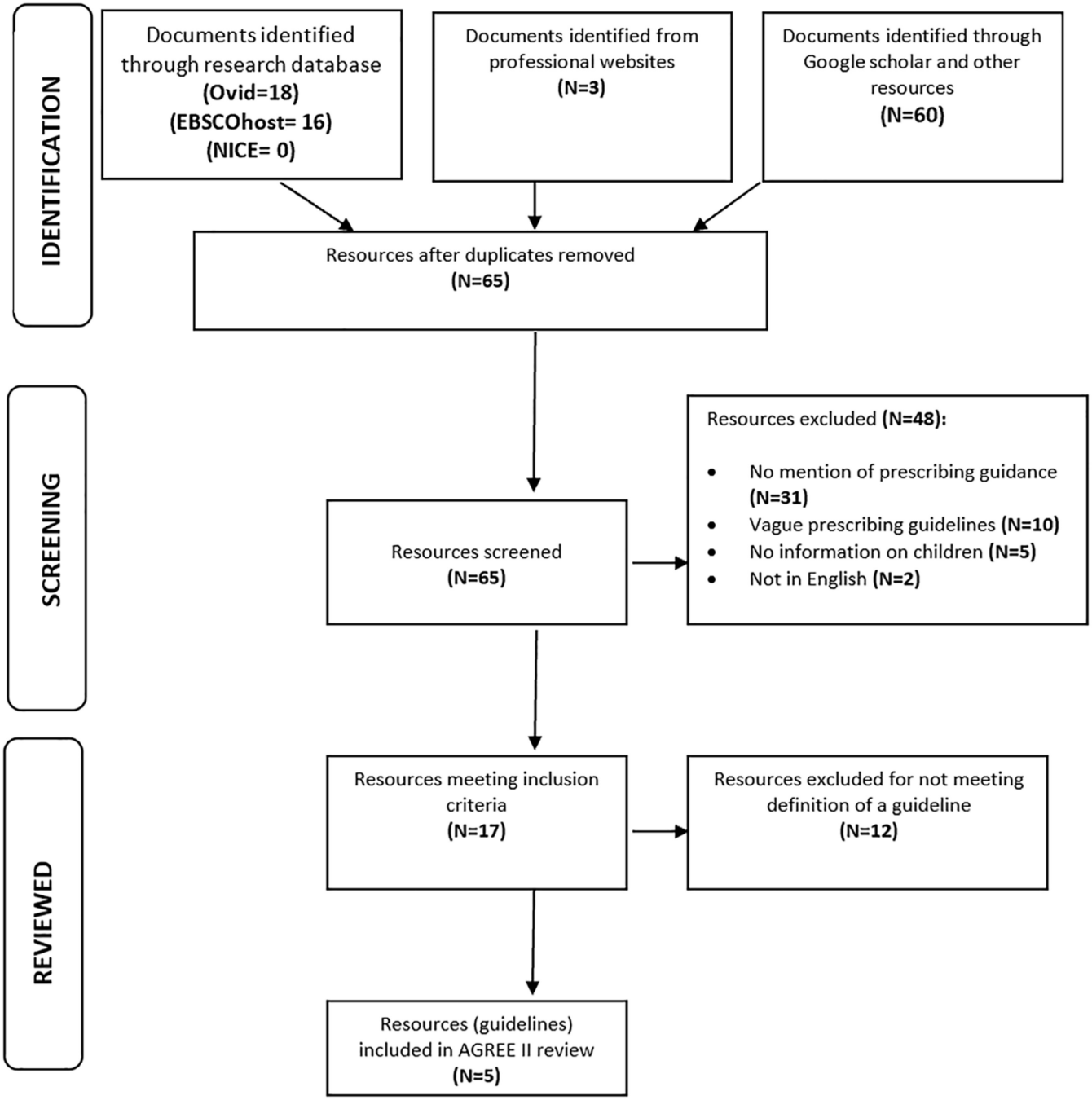

FIGURE 1 PRISMA diagram[69] showing scoping and review of guidance and local protocols relating to managing refractive error in children.

The demographic characteristics of the expert Delphi panel can be found in Appendix 3. The statements and corresponding agreement scores from Round 1 are presented in Tables 2–5. The average ICC of 0.58 with a 95% confidence interval from 0.48 to 0.67, $F(167, 1503) = 2.63$, $p < 0.001$ indicated moderate agreement between panel members. Cronbach's alpha (α) of 0.97 indicated high reliability of responses. The panel reached consensus on 85 prescribing statements as appropriate and 32 as inappropriate. The 51 statements that did not achieve consensus were carried through to Round 2 (Tables 2–5). The average ICC was 0.672 with a 95% confidence interval from 0.53 to 0.79, $F(50, 450) = 3.337$, $p < 0.001$. Responses were highly reliable ($\alpha = 0.878$). The panel reached consensus on nine statements as appropriate and 13 as inappropriate. The remaining 29 statements that did not reach consensus were carried through to the final round. The average ICC was 0.51 with a 95% confidence interval from 0.21 to 0.73, $F(28, 252) = 2.09$, $p = 0.002$. Round 3 had a lower reliability score ($\alpha = 0.62$) compared to Rounds 1 and 2. At the end of the third round, the panel reached consensus on one statement as appropriate and 25 statements as inappropriate (Tables 2–5), while three did not obtain consensus.

TABLE 1 Quality of guidelines based on the six domains of the appraisal tool (AGREE II).

Clinical guideline	AGREE II domains (%)						Quality	Agreement (ICC)
	Scope and purpose	Stakeholder involvement	Rigour of development	Clarity of presentation	Applicability	Editorial independence		
All India Ophthalmological Society Guidelines (2017)[70]	53	39	8	78	6	38	Low	0.902
Guidelines for Prescribing Optical Correction in Children (Wutthiphan, 2005)[71]	28	11	4	33	2	0	Low	0.536
Pediatric Eye Evaluations Preferred Practice Pattern® (American Academy of Ophthalmology, 2017)[36]	89	64	70	94	19	92	**High**	**0.957**
To prescribe or not to prescribe? Guidelines for spectacle prescribing in infants and children (Leat, 2011)[34]	86	28	23	64	17	0	Low	0.808
Evidence-based spectacle prescribing for infants and children (Bobier, 2007)[14]	36	19	22	50	6	0	Low	0.690
Median (range) %	**53 (28–89)**	**28 (11–64)**	**22 (4–70)**	**62 (33–94)**	**6 (2–19)**	**0 (0–92)**		

Note: Domain score = (Obtained score − Minimum possible score)/(Maximum possible score − Minimum possible score) × 100. Minimum possible score = 1 (strongly disagree) × (number of items) × (number of appraisers) and the maximum possible score = 7 (strongly agree) × (number of items) × (number of appraisers).
Values in bold indicate Agreement ICC significant at the $p < 0.05$ value.

There was a 100% response rate for all three rounds. There was no statistically significant difference in the agreement scores between rounds and between each professional group, that is, optometrists, orthoptists and ophthalmologists ($p > 0.05$). As well as agreement scores, the 10 panel members were given the opportunity to make comments to justify their responses. Given that not all panel members consistently provided additional written feedback on all the statements, a formal thematic analysis was not conducted. This would not have been appropriate given that this was not the intended use of the questionnaire. However, the feedback gathered does provide helpful information to explain the findings (see Discussion). A sample of these quotes and a summary of points on which agreement was achieved are provided in Table 6.

The Delphi process provided a final set of 95 (Round 1: 85 + Round 2: 9 + Round 3: 1) prescribing statements that reached expert consensus and were considered appropriate prescribing recommendations. These are presented in Table 7, categorised into four different age groups and various clinical scenarios based on level of vision, presence of anisometropia and/or presence of constant esotropia. If the statements did not specify whether the full or moderated correction should be prescribed, this was presented as not specified.

DISCUSSION

Prescribing refractive error correction in children is widely conducted by optometrists and paediatric ophthalmologists; however, there tend to be discrepancies in practice within and between professions.[17–19] Clinical guidelines provide evidence-based recommendations to aid clinical decision making, hence enhancing consistency among eye care practitioners. Following a comprehensive search, this study identified 65 current clinical guidelines relating to prescribing a refractive error correction in children. Five clinical guidelines that met the inclusion criteria were evaluated for their methodological quality using the AGREE II tool. The overall quality ranged from high to low, with the median percentage score for four of the six domains being below 30%. The lowest scoring domains were 'Stakeholder Involvement', 'Rigour of Development', 'Applicability' and 'Editorial Independence'. A score below 30% in these domains is of concern as they relate to the development of the guideline, the research team involved in selecting and reviewing evidence, the methods by which recommendations are made, the barriers and facilitators to guideline application, any conflicts of interests and how these impacted the guideline. It is important for practitioners using clinical guidelines to be able to identify the evidence source that underpins the recommendations in that guideline.

Transparency in reporting conflicts of interest is paramount to avoid biased recommendations. Unfortunately, most of the guidelines referenced for this study failed to

TABLE 2 Results from Delphi Rounds 1–3 for age <1 year (refractive error found via a cycloplegic refraction with no risk factors identified following a comprehensive eye examination).

	Round 1				Round 2				Round 3			
Scenario	**Refractive error**	**Give: Full (F)/ modified (M)/not specified (NS)**	**Median score (9 = strongly agree)**	**Interquartile range (IQR)**	**Refractive error**	**Give: Full (F)/ modified (M)/not specified (NS)**	**Median score (9 = strongly agree)**	**IQR**	**Refractive error**	**Give: Full (F)/ modified (M)/not specified(NS)**	**Median score (9 = strongly agree)**	**IQR**
<1 Year: No visual concerns	Hyperopia ≥ +6.00 DS	F	3.5	2.25–5.75								
	Hyperopia ≥ +6.00 DS	M	No consensus	N/A	Hyperopia ≥ +6.00 DS	M	No consensus	N/A	Hyperopia ≥ +6.00 DS	M	5.0	5.00–6.00
	Myopia ≥ −5.00 DS	F	No consensus	N/A	Myopia ≥ −5.00 DS	F	3.0	3.00–5.00				
	Myopia ≥ −5.00 DS	M	5.0	3.00–8.00								
	Astigmatism ≥ −3.00 DC (oblique)	F	No consensus	No consensus	Astigmatism ≥ −3.00 DC (oblique)	F	3.0	3.00–4.75				
	Astigmatism ≥ −3.00 DC (oblique)	M	5.0	2.25–8.00								
	Astigmatism ≥ −3.00 DC (not oblique)	F	No consensus	N/A	Astigmatism ≥ −3.00 DC (not oblique)	F	N/A	N/A	Astigmatism ≥ −3.00 DC (not oblique)	F	4.5	4.00–5.00
	Astigmatism ≥ −3.00 DC (not oblique)	M	No consensus	N/A	Astigmatism ≥ −3.00 DC (not oblique)	M	No consensus	N/A	Astigmatism ≥ −3.00 DC (not oblique)	M	6.0	5.00–6.00
	Astigmatism ≥ −2.50 DC (not oblique)	F	No consensus	N/A	Astigmatism ≥ −2.50 DC (not oblique)	F	No consensus	N/A	Astigmatism ≥ −2.50 DC (not oblique)	F	No consensus	N/A
	Astigmatism ≥ −2.50 DC (not oblique)	M	No consensus	N/A	Astigmatism ≥ −2.50 D (not oblique)	M	No consensus	N/A	Astigmatism ≥ −2.50 DC (not oblique)	M	No consensus	N/A
	Astigmatism ≥ −3.00 DC (not oblique)	NS	3.0	2.00–4.75								
<1 Year: Vision reduced	Hyperopia ≥ +6.00 DS	F	5.0	3.25–6.75								
	Hyperopia ≥ +6.00 DS	M	5.0	3.25–7.75								
	Myopia ≥ −5.00 DS	F	5.0	3.00–7.25								
	Myopia ≥ −5.00 DS	M	5.0	3.25–8.00								
	Astigmatism ≥ −3.00 DC (oblique)	F	6.0	5.00–7.00								
	Astigmatism ≥ −3.00 DC (oblique)	M	5.0	4.25–7.75								
	Astigmatism ≥ −3.00 DC (not oblique)	M	5.0	4.25–6.00								

TABLE 2 (Continued)

	Round 1				Round 2				Round 3			
Scenario	**Refractive error**	**Give: Full (F)/ modified (M)/not specified (NS)**	**Median score (9 = strongly agree)**	**Interquartile range (IQR)**	**Refractive error**	**Give: Full (F)/ modified (M)/not specified (NS)**	**Median score (9 = strongly agree)**	**IQR**	**Refractive error**	**Give: Full (F)/ modified (M)/not specified(NS)**	**Median score (9 = strongly agree)**	**IQR**
<1 Year: No visual concerns, but anisometropic (with criterion level to be corrected)	Hyperopia ≥ +2.50 DS	F	No consensus	N/A	Hyperopia ≥ +2.50 DS	F	7.0	5.25–7.75				
	Hyperopia ≥ +2.50 DS	NS	6.5	3.50–8.00								
	Hyperopia ≥ +2.50 DS	M	7.0	4.25–8.50								
	Myopia ≥ −4.00 DS	F	No consensus	N/A	Myopia ≥ −4.00 DS	F	6.5	5.00–7.75				
	Myopia ≥ −4.00 DS	M	7.4	5.00–9.00								
	Myopia ≥ −4.00 DS	NS	No consensus	N/A	Myopia ≥ −4.00 DS	NS	4.0	3.00–5.00				
	Astigmatism ≥ −2.50 DC (oblique)	F	7.0	2.00–9.00								
	Astigmatism ≥ −2.50 DC (oblique)	NS	5.0	3.50–6.75								
	Astigmatism ≥ −2.50 DC (oblique)	M	7.0	4.25–7.75								
	Astigmatism ≥ −2.50 DC (not oblique)	NS	5.0	3.50–5.75								
<1 Year: Vision reduced and anisometropic (with criterion level to be corrected)	Hyperopia ≥ +2.50 DS	F	6.0	2.25–6.75								
	Hyperopia ≥ +2.50 DS	M	8.0	6.25–8.00								
	Hyperopia ≥ +2.50 DS	NS	8.0	4.25–9.00								
	Myopia ≥ −4.00 DS	F	7	3.75–8.75								
	Myopia ≥ −4.00 DS	M	7.5	7.00–8.00								
	Myopia ≥ −4.00 DS	NS	6.0	5.00–7.75								
	Astigmatism ≥ −2.50 DC (oblique)	F	6.5	3.50–8.50								
	Astigmatism ≥ −2.50 DC (oblique)	M	7.0	6.25–8.00								
	Astigmatism ≥ −2.50 DC (oblique)	NS	8.5	4.25–9.00								
	Astigmatism ≥ −2.50 DC (not oblique)	F	6.0	5.00–6.00								
	Astigmatism ≥ −2.50 DC (not oblique)	M	7.5	7.00–8.00								
	Astigmatism ≥ −2.50 DC (not oblique)	NS	7.5	3.75–8.75								
<1 Year: Constant esotropia	Hyperopia ≥ +2.00 DS	F	9.0	9.00–9.00								
	Hyperopia ≥ +2.00 DS	M	2.0	1.00–4.50								

Note: Statements reached consensus as being appropriate with a median score of ≥6 (green) or inappropriate (pink) with a median score of ≤6. Lack of consensus is indicated in amber. N/A, not applicable.

TABLE 3 Results from Delphi Rounds 1–3 for ages 1–2 years (refractive error found via a cycloplegic refraction with no risk factors identified following a comprehensive eye examination).

	Round 1				Round 2				Round 3			
Scenario	**Refractive error**	**Give: Full (F)/ modified (M)/not specified(NS)**	**Median score (9 = strongly agree)**	**Interquartile range (IQR)**	**Refractive error**	**Give: Full (F)/ modified (M)/not specified (NS)**	**Median score (9 = strongly agree)**	**IQR**	**Refractive error**	**Give: Full (F)/ modified (M)/not specified (NS)**	**Median score (9 = strongly agree)**	**IQR**
1–2 Years: No visual concerns	Hyperopia ≥ +5.00 DS	F	No consensus	N/A	Hyperopia ≥ +5.00 DS	F	No consensus	N/A	Hyperopia ≥ +5.00 DS	F	5.0	3.50–5.00
	Hyperopia ≥ +5.00 DS	M	5.0	4.75–9.00								
	Myopia ≥ −4.00 DS	F	No consensus	N/A	Myopia ≥ −4.00 DS	F	No consensus	N/A	Myopia ≥ −4.00 DS	F	No consensus	N/A
	Myopia ≥ −4.00 DS	M	7.0	4.75–9.00								
	Astigmatism ≥ −2.50 DC (oblique)	F	5.0	4.00–6.75								
	Astigmatism ≥ −2.50 DC (oblique)	M	7.0	7.00–7.75								
	Astigmatism ≥ −2.50 DC (not oblique)	F	No consensus	N/A	Astigmatism ≥ −2.50 DC (not oblique)	F	4.0	3.25–5.00				
	Astigmatism ≥ −2.50 DC (not oblique)	M	7.0	6.00–7.00								
1–2 Years: Vision reduced	Hyperopia ≥ +5.00 DS	F	7.0	5.25–7.75								
	Hyperopia ≥ +5.00 DS	M	7	4.00–8.75								
	Myopia ≥ −2.00 DS	F	6.5	5.00–7.75								
	Myopia ≥ −4.00 DS	M	7.0	2.25–8.75								
	Astigmatism ≥ −2.50 DC (oblique)	F	6.5	5.25–7.00								
	Astigmatism ≥ −2.50 DC (oblique)	M	6.5	6.00–7.75								
	Astigmatism ≥ −2.50 DC (not oblique)	F	6.0	5.00–7.00								
	Astigmatism ≥ −2.50 DC (not oblique)	M	6.5	6.00–7.75								
1–2 Years: No visual concerns, but anisometropic (with criterion level to be corrected)	Hyperopia ≥ +2.00 DS	F	8.0	6.50–9.00								
	Hyperopia ≥ +2.00 DS	M	7.5	3.00–8.75								
	Hyperopia ≥ +2.00 DS	NS	No consensus	N/A	Hyperopia ≥ +2.00 DS	NS	No consensus	N/A	Hyperopia ≥ +2.00 DS	NS	4.5	4.00–5.00
	Myopia ≥ −3.00 DS	F	8.5	6.50–9.00								
	Myopia ≥ −3.00 DS	M	No consensus	N/A	Myopia ≥ −3.00 DS	M	No consensus	N/A	Myopia ≥ −3.00 DS	M	4.0	3.25–4.00
	Myopia ≥ −3.00 DS	NS	6.5	3.25–8.00								

TABLE 3 (Continued)

Scenario	Round 1				Round 2				Round 3			
	Refractive error	Give: Full (F)/ modified (M)/not specified(NS)	Median score (9 = strongly agree)	Interquartile range (IQR)	Refractive error	Give: Full (F)/ modified (M)/not specified (NS)	Median score (9 = strongly agree)	IQR	Refractive error	Give: Full (F)/ modified (M)/not specified (NS)	Median score (9 = strongly agree)	IQR
1–2 Years: Vision reduced and anisometropic (with criterion level to be corrected)	Astigmatism ≥ −2.00 DC (oblique)	F	7.0	6.25–8.75								
	Astigmatism ≥ −2.00 DC (oblique)	M	No consensus	N/A	Astigmatism ≥ −2.00 DC (oblique)	M	6.0	5.00–6.00				
	Astigmatism ≥ −2.00 DC (oblique)	NS	5.0	4.00–6.00								
	Astigmatism ≥ −2.00 DC (not oblique)	F	7.0	6.25–8.75								
	Astigmatism ≥ −2.00 DC (not oblique)	M	6.5	2.00–8.75								
	Astigmatism ≥ −2.00 DC (not oblique)	NS	No consensus	N/A	Astigmatism ≥ −2.00 DC (not oblique)	NA	No consensus	N/A	Astigmatism ≥ −2.00 DC (not oblique)	NS	5.0	4.25–5.00
	Hyperopia ≥ +2.00 DS	F	No consensus	N/A	Hyperopia ≥ +2.00 DS	F	8.5	7.25–9.00				
	Hyperopia ≥ +2.00 DS	M	5.00	3.00–8.00								
	Hyperopia ≥ +2.00 DS	NS	7.0	2.25–7.00								
	Myopia ≥ −3.00 DS	F	8.0	6.00–8.00								
	Myopia ≥ −3.00 DS	M		N/A	Myopia ≥ −3.00 DS	M	No consensus	N/A	Myopia ≥ −3.00 DS	M	5.0	4.00–5.75
	Myopia ≥ −3.00 DS	NS	7.0	3.50–7.00								
	Astigmatism ≥ −2.00 DC (oblique)	F	4.0	3.25–6.50								
	Astigmatism ≥ −2.00 DC (oblique)	M	No consensus	N/A	Astigmatism ≥ −2.00 DC (oblique)	M	No consensus	N/A	Astigmatism ≥ −2.00 DC (oblique)	M	5.0	4.25–5.75
	Astigmatism ≥ −2.00 DC (oblique)	NS	8.5	5.25–9.00								
	Astigmatism ≥ −2.00 DC (not oblique)	F	5.0	4.25–7.00								
	Astigmatism ≥ −2.00 DC (not oblique)	M	No consensus	N/A	Astigmatism ≥ −2.00 DC (not oblique)	M	No consensus	N/A	Astigmatism ≥ −2.00 DC (not oblique)	M	5.0	5–5.75
	Astigmatism ≥ −2.00 DC (not oblique)	NS	7.0	7.00–8.00								
1–2 Years: Constant esotropia	Hyperopia ≥ +2.00 DS	F	9.0	9.00–9.00								
	Hyperopia ≥ +2.00 DS	M	2.0	1.00–6.25								

Note: Statements reached consensus as being appropriate with a median score of ≥6 (green) or inappropriate (pink) with a median score of ≤5. Lack of consensus is indicated in amber. N/A, not applicable.

TABLE 4 Results from Delphi Rounds 1–3 for ages 2–3 years (refractive error found via a cycloplegic refraction with no risk factors identified following a comprehensive eye examination).

	Round 1				Round 2				Round 3			
Scenario	**Refractive error**	**Give: Full (F)/ modified (M)/ not specified (NS)**	**Median score (9 = strongly agree)**	**Interquartile range (IQR)**	**Refractive error**	**Give: Full (F)/ modified (M)/ not specified (NS)**	**Median score (9 = strongly agree)**	**IQR**	**Refractive error**	**Give: Full (F)/modified (M)/not specified (NS)**	**Median score (9 = strongly agree)**	**IQR**
2–3 Years: No visual concerns	Hyperopia ≥ +4.50 DS	F	7.5	4.00–8.00								
	Hyperopia ≥ +4.50 DS	M	9.0	6.00–9.00								
	Hyperopia ≥ +4.50 DS	NS	No consensus	N/A	Hyperopia ≥ +4.50 DS	NS	No consensus	N/A	Hyperopia ≥ +4.50 DS	NS	3.5	3–4.75
	Myopia ≥ −3.00 DS	F	7.5	4.75–9.00								
	Myopia ≥ −3.00 DS	M	No consensus	N/A	Myopia ≥ −3.00 DS	M	No consensus	N/A	Myopia ≥ −3.00 DS	M	5.0	3.25–6
	Myopia ≥ −3.00 DS	NS	No consensus	N/A	Myopia ≥ −3.00 DS	NS	No consensus	N/A	Myopia ≥ −3.00 DS	NS	3.0	2.25–3
	Astigmatism ≥ −2.00 DC (oblique)	F	7.0	5.25–8.00								
	Astigmatism ≥ −2.00 DC (oblique)	M	8.5	5.00–9.00								
	Astigmatism ≥ −2.00 DC (not oblique)	M	8.0	7.25–9.00								
	Astigmatism ≥ −2.00 DC (not oblique)	F	No consensus	N/A	Astigmatism ≥ −2.00 DC (not oblique)	F	No consensus	N/A	Astigmatism ≥ −2.00 DC (not oblique)	F	5.0	4–6.75
2–3 Years: Vision reduced	Hyperopia ≥ +4.50 DS	F	6.5	3.75–7.00								
	Myopia ≥ −3.00 DS	F	8.0	6.25–9.00								
	Astigmatism ≥ −2.00 DC (oblique)	F	6.5	5.25–7.00								
	Astigmatism ≥ −2.00 DC (oblique)	M	5.0	2.25–6.50								
	Astigmatism ≥ −2.00 DC (not oblique)	F	6.0	5.00–6.75								
	Astigmatism ≥ −2.00 DC (not oblique)	M	5.0	2.25–6.50								

TABLE 4 (Continued)

Scenario	Round 1				Round 2				Round 3			
	Refractive error	Give: Full (F)/ modified (M)/ not specified (NS)	Median score (9 = strongly agree)	Interquartile range (IQR)	Refractive error	Give: Full (F)/ modified (M)/ not specified (NS)	Median score (9 = strongly agree)	IQR	Refractive error	Give: Full (F)/modified (M)/not specified (NS)	Median score (9 = strongly agree)	IQR
2–3 Years: No visual concerns, but anisometropic (with criterion level to be corrected)	Hyperopia ≥ +1.50 DS	F	No consensus	N/A	Hyperopia ≥ +1.50 DS	F	6.0	4.25–7.00				
	Hyperopia ≥ +1.50 DS	M	No consensus	N/A	Hyperopia ≥ +1.50 DS	M	No consensus	N/A	Hyperopia ≥ +1.50 DS	M	5.0	5.00–5.75
	Hyperopia ≥ +1.50 DS	NS	No consensus	N/A	Hyperopia ≥ +1.50 DS	NA			Hyperopia ≥ +1.50 DS	NS	5.0	4.25–5.75
	Myopia ≥ −3.00 DS	F	9.0	3.50–9.00								
	Myopia ≥ −3.00 DS	M	No consensus	N/A	Myopia ≥ −3.00 DS	M	No consensus	N/A	Myopia ≥ −3.00 DS	M	4.5	2.50–5.00
	Myopia ≥ −3.00 DS	NS	No consensus	N/A	Myopia ≥ −3.00 DS	NS	No consensus	N/A	Myopia ≥ −3.00 DS	NS	5.0	4.25–6.75
	Astigmatism ≥ −2.00 DC (oblique)	F	7.0	3.00–8.75								
	Astigmatism ≥ −2.00 DC (oblique)	M	No consensus	N/A	Astigmatism ≥ −2.00 DC (oblique)	M	No consensus	N/A	Astigmatism ≥ −2.00 DC (oblique)	M	5.5	4.25–6.00
	Astigmatism ≥ −2.00 DC (oblique)	NS	5.0	4.25–7.25								
	Astigmatism ≥ −2.00 DC (not oblique)	F	No consensus	N/A	Astigmatism ≥ −2.00 DC (not oblique)	F	6.0	5.00–7.00				
	Astigmatism ≥ −2.00 DC (not oblique)	M	8.5	4.00–9.00								
	Astigmatism ≥ −2.00 DC (not oblique)	NS	No consensus	N/A	Astigmatism ≥ −2.00 DC (not oblique)	NS	No consensus	N/A	Astigmatism ≥ −2.00 DC (not oblique)	NS	5.0	5.00–5.75
2–3 Years: Vision reduced and anisometropic (with criterion level to be corrected)	Hyperopia ≥ +1.50 DS	F	8.0	8.00–8.75								
	Hyperopia ≥ +1.50 DS	M	No consensus	N/A	Hyperopia ≥ +1.50 DS	M	No consensus	N/A	Hyperopia ≥ +1.50 DS	M	3.5	3.00–4.75
	Hyperopia ≥ +1.50 DS	NS	7.5	6.00–9.00								
	Myopia ≥ −3.00 DS	F	8.0	7.00–8.75								
	Myopia ≥ −3.00 DS	M	3.0	2.00–8.75								
	Myopia ≥ −3.00 DS	NS	8.0	4.00–9.00								
	Astigmatism ≥ −2.00 DC (oblique)	F	8.0	7.25–8.75								
	Astigmatism ≥ −2.00 DC (oblique)	M	No consensus	N/A	Astigmatism ≥ −2.00 DC (oblique)	M	4.0	3.00–5.75				
	Astigmatism ≥ −2.00 DC (oblique)	NS	6.0	5.25–7.75								
	Astigmatism ≥ −2.00 DC (not oblique)	F	5.0	4.00–7.50								

(Continues)

TABLE 4 (Continued)

Scenario	Round 1				Round 2				Round 3		
	Refractive error	Give: Full (F)/ modified (M)/ not specified (NS)	Median score (9 = strongly agree)	Interquartile range (IQR)	Refractive error	Give: Full (F)/ modified (M)/not specified (NS)	Median score (9 = strongly agree)	IQR	Refractive error	Give: Full (F)/modified (M)/not specified (NS)	Median score (9 = strongly agree)	IQR
2–3 Years: Constant esotropia	Astigmatism ≥ −2.00 DC (not oblique)	M	No consensus	N/A	Astigmatism ≥ −2.00 DC (not oblique)	M	4.0	3.00–5.75				
	Astigmatism ≥ −2.00 DC (not oblique)	NS	9.0	8.00–9.00								
	Hyperopia ≥ +1.50 DS	F	9.0	9.00–9.00								
	Hyperopia ≥ +1.50 DS	M	2.0	1.00–4.50								

Note: Statements reached consensus as being appropriate with a median score of ≥6 (green) or inappropriate (pink) with a median score of ≤5. Lack of consensus is indicated in amber. N/A, nor applicable.

meet the domain criteria. Patient engagement during the development of these clinical practice guidelines was also notably very poor. This highlights the importance of stakeholder engagement during development of clinical guidelines that will be used by eye care professionals to assist in prescribing refractive error correction in children. A strength of the critical appraisal stage is that it was conducted independently by two researchers using a well-known appraisal tool (AGREE II) which has been established and validated for the evaluation of guidelines.[52] Similar methods have been used when exploring guidelines for management of other ocular conditions, which have reported similar findings in that eye care guidelines are low scoring in particular AGREE II domains, and that there is scope for improving current guidelines.[72]

Only one guideline (Pediatric Eye Evaluations Preferred Practice Pattern)[36] achieved a high score in five of the six domains during the AGREE II appraisal and was therefore identified as being of high quality. Using the 23 items in the AGREE II tool in the evaluation may help improve the methodology and development of future prescribing guidelines. However, it is acknowledged that the development of high-quality guidelines requires time, expertise and resources.

The expert panel involved in the Delphi study consisted of a multi-disciplinary team with a wide range of experience in paediatric eye care based in primary and secondary settings. We minimised potential sampling bias by ensuring the expert panel consisted of a multidisciplinary team, and that all members had extensive experience in paediatric eye care. Of the 168 prescribing recommendation statements, 95 reached agreement as clinically appropriate and should be considered when prescribing refractive correction in children. The only additional information that members of the expert panel had from one round to the next was the group score, enabling a comparison between the group score and their own score for the preceding round. This only occurred for 10 statements that gained consensus in Rounds 2 and 3, with the majority (85) reaching consensus at the end of Round 1, demonstrating while the modified Delphi technique is a robust method for gathering autonomous expert opinions, there was a high level of consensus within the expert panel. These findings highlight the extent to which the current paediatric spectacle prescribing guideline recommendations do not align with the prescribing patterns used by paediatric eye care providers. The prescribing statements that were ultimately discarded during the Delphi process were a result of non-consensus among the expert panel members. This disparity emphasises the inherent variability among experts regarding when and what to prescribe for children in a real-world setting, even when relying on high-quality guidelines such as the American Academy of Ophthalmology (AAO) Preferred Practice Pattern (PPP). The reasons for the lack of consensus on certain recommendations extend beyond the scope of the AAO PPP guidelines. Indeed, these are due to factors that were not explicitly addressed in the guideline, such as family history, individual

TABLE 5 Results from Delphi Rounds 1–3 for ages 3–4 years (refractive error found via a cycloplegic refraction with no risk factors identified following a comprehensive eye examination).

	Round 1				Round 2				Round 3			
Scenario	**Refractive error**	**Give: Full (F)/ modified (M)/ not specified (NS)**	**Median score (9 = strongly agree)**	**Interquartile range (IQR)**	**Refractive error**	**Give: Full (F)/ modified (M)/ not specified (NS)**	**Median score (9 = strongly agree)**	**IQR**	**Refractive error**	**Give: Full (F)/ modified (M)/not specified (NS)**	**Median score (9 = strongly agree)**	**IQR**
3–4 Years: No visual concerns	Hyperopia ≥ +3.50 DS	F	No consensus	N/A	Hyperopia ≥ +3.50 DS	F	No consensus	N/A	Hyperopia ≥ +3.50 DS	F	5.5	4.25–6
	Hyperopia ≥ +3.50 DS	M	8	5.00–9.00								
	Myopia ≥ −2.50 DS	F	8.5	5.5–9								
	Myopia ≥ −2.50 DS	M	9	7.00–9.00								
	Astigmatism ≥ −1.50 DC (oblique)	F	6	5–7.75								
	Astigmatism ≥ −1.50 DC (oblique)	M	8	7.25–8								
	Astigmatism ≥ −1.50 DC (not oblique)	F	No consensus	N/A	Astigmatism ≥ −1.50 DC (not oblique)	F	6	5.00–6.00				
	Astigmatism ≥ −1.50 DC (not oblique)	M	No consensus	N/A	Astigmatism ≥ −1.50 DC (not oblique)	M	6	4.25–6				
3–4 Years: Vision reduced	Hyperopia ≥ +3.50 DS	F	3	1–6.25								
	Hyperopia ≥ +3.50 DS	M	No consensus	N/A	Hyperopia ≥ +3.50 DS	M	3	2.00–4.00				
	Myopia ≥ −2.50 DS	F	8	7.00–8.00								
	Myopia ≥ −2.50 DS	M	No consensus	N/A	Myopia ≥ −2.50 DS	M	2	1.25–3				
	Astigmatism ≥ −1.50 DC (oblique)	F	6.5	1.75–7								
	Astigmatism ≥ −1.50 DC (oblique)	M	3	2–6.25								
	Astigmatism ≥ −1.50 DC (not oblique)	F	6	4.25–7								
	Astigmatism ≥ −1.50 DC (not oblique)	M	No consensus	N/A	Astigmatism ≥ −1.50 DC (not oblique)	M	2	2.00–3.00				
3–4 Years: No visual concerns, but anisometropic (with criterion level to be corrected)	Hyperopia ≥ +1.50 DS	F	No consensus	N/A	Hyperopia ≥ +1.50 DS	F	No consensus	N/A	Hyperopia ≥ +1.50 DS	F	5	5–6.5
	Hyperopia ≥ +1.50 DS	M	7.5	4.00–9.00								
	Hyperopia ≥ +1.50 DS	NS	No consensus	N/A	Hyperopia od +1.50 DS	NS	No consensus	N/A	Hyperopia od +1.50 DS	NS	5	5.00–6.00
	Myopia ≥ −2.50 DS	NS	No consensus	N/A	Myopia ≥ −2.50 DS	NS	6.5	5.25–7.75				
	Myopia ≥ −2.50 DS	F	7.5	3.00–9.00								
	Myopia ≥ −2.50 DS	M	No consensus	N/A	Myopia ≥ −2.50 DS	M	3	1.25–4.75				
	Astigmatism ≥ −1.50 DC (oblique)	F	6.5	3–8.5								
	Astigmatism ≥ −1.50 DC (oblique)	M	9	5.75–9								

(Continues)

TABLE 5 (Continued)

	Round 1				Round 2				Round 3			
Scenario	**Refractive error**	**Give: Full (F)/ modified (M)/ not specified (NS)**	**Median score (9 = strongly agree)**	**Interquartile range (IQR)**	**Refractive error**	**Give: Full (F)/ modified (M)/ not specified (NS)**	**Median score (9 = strongly agree)**	**IQR**	**Refractive error**	**Give: Full (F)/ modified (M)/not specified (NS)**	**Median score (9 = strongly agree)**	**IQR**
	Astigmatism ≥ −1.50 DC (oblique)	NS	No consensus	N/A	Astigmatism ≥ −1.50 DC (oblique)	NS	No consensus	N/A	Astigmatism ≥ −1.50 DC (oblique)	NS	5	5.00–6.00
	Astigmatism ≥ −1.50 DC (not oblique)	F	8	4.00–9.00								
	Astigmatism ≥ −1.50 DC (not oblique)	M	8	7.00–9.00								
	Astigmatism ≥ −1.50 DC (not oblique)	NS	No consensus	N/A	Astigmatism ≥ −1.50 DC (not oblique)	NS	No consensus	N/A	Astigmatism ≥ −1.50 DC (not oblique)	NS	5	4.25–5.75
3–4 Years: Vision reduced and anisometropic (with criterion level to be corrected)	Hyperopia ≥ +1.50 DS	F	5	1.75–7.25								
	Hyperopia ≥ +1.50 DS	M	No consensus	N/A	Hyperopia ≥ +1.50 DS	M	3	2.00–4.00				
	Hyperopia ≥ +1.50 DS	NS	9	7.5–9								
	Myopia ≥ −2.50 DS	F	8.5	8.00–9.00								
	Myopia ≥ −2.50 DS	M	2	1–4.75								
	Myopia ≥ −2.50 DS	NS	8	6.25–9								
	Astigmatism ≥ −1.50 DC (oblique)	F	4	2.25–5								
	Astigmatism ≥ −1.50 DC (oblique)	M	No consensus	N/A	Astigmatism ≥ −1.50 DC (oblique)	M	3	2–3.75				
	Astigmatism ≥ −1.50 DC (oblique)	NS	8	8.00–9.00								
	Astigmatism ≥ −1.50 DC (not oblique)	F	4	3.00–5.00								
	Astigmatism ≥ −1.50 DC (not oblique)	M	No consensus	N/A	Astigmatism ≥ −1.50 DC (not oblique)	M	3	2–3.75				
	Astigmatism ≥ −1.50 DC (not oblique)	NS	9	8.00–9.00								
3–4 Years: Constant esotropia	Hyperopia ≥ +1.50 DS	F	9	8.25–9								
	Hyperopia ≥ +1.50 DS	M	2	1.25–8								

Note: Statements reached consensus as being appropriate with a median score of ≥6 (green) or inappropriate (pink) with a median score of ≤5. Lack of consensus is indicated in amber. N/A, not applicable.

TABLE 6 Sample of quotes obtained during Round 1 for different age groups and visual concerns when prescribing refractive error.

Scenario	Sample quotes	Comments
<1 Year: No visual concerns	'In most cases, should vision be at normal range—for a child under 1 year of age, I would most likely monitor the child regularly between 8 and 12 weeks and prescribe when needed'. 'I do not prescribe glasses in children under one unless the refractive error is very high and visual behaviour is poor. A refractive error of over 5 (more than or equal to −5.00 D) can be 6 or 16 [D]. If it is very high, I do give a prescription with reduction of two dioptres'.	Consensus reached that prescribing statements for hyperopia or myopia were not appropriate.
<1 Year: Vision reduced	'I would probably repeat refraction another day before feeling confident to prescribe at this young age group'. 'I would reassess within 6 months and, depending on emmetropisation trajectory, might adjust the prescription. I would generally give full sphere but might under-correct cyls a little at first—but in practice, if you are giving a baby glass [glasses], why not the full correction? At these high levels of error, emmetropisation is probably not active, and if they cannot be emmetropic, why give a partial correction?'	Consensus reached that prescribing statements for hyperopia or myopia were not appropriate.
<1 Year: No visual concerns, but anisometropia with criterion level to be corrected	'I would prescribe full myopic correction whether there is a difference between the eyes or not. I would correct the cyl (adjusted if the sphere is reduced). I may reduce a hyperopia prescription but always correct the difference between the eyes'. 'The prescription of glasses depends on how the parents accept the diagnosis and their willingness to try the prescription for the child. In the area where I am, most patients are socially deprived and have multiple children and are not keen to try glasses. I would prescribe if the child is closer to one [years of age] and was cooperative for the tests and I have a reliable refraction and vision results'.	Consensus reached that prescribing full hyperopic anisometropia ≥ +2.50 DS or myopic anisometropia ≥ −4.00 DS prescription was appropriate.
<1 Year: Constant esotropia	'It all depends on the cover test results. This should be checked before cyclo to determine how much plus eliminates the esotropia. Exceptionally, full plus could change an esotropia to an exotropia'. 'Esotropia—Full plus'. 'I would always try full plus as first-line management in an esotropic infant. But if the hypermetropia was mild (2–3 D) and it made no difference to the control of the deviation, I might allow the parents to discard glasses for a while if they were finding them difficult. Then refract again after 6 months and see how emmetropisation is going, then make another decision'. 'Prescribing depends on the child's milestones and development and associated comorbidities. In a child developing normally otherwise, I would not prescribe for 3.00 DS but prescribe a 7.00 DS or more'.	Agreement was obtained that the full prescription should be given, and consensus was also obtained that giving a modified prescription would be inappropriate in this situation.
1–2 years: Vision reduced	'I would be less likely to partial prescribe if VA is poor or BV issues'. 'If the astigmatism was part of a more complex error with myopia/hypermetropia too, I might give the full sphere, but if the astigmatism was emmetropising in relation to earlier refraction, I might continue to under correct the cyl component. Also depends on whether I have seen the child before and whether they show any sign of emmetropisation—if they do, then maybe under-correct, if not, why give an under-correction?'	Agreement was obtained on prescribing the full or modifying the prescription appropriately.
1–2 years: Vision reduced and anisometropia, with criterion level ≥ anisometropia to be corrected	'But norms at this age have very wide confidence intervals, so often very difficult to be sure VA is reduced on only one visit. Also, as before, astigmatism does not usually occur in isolation, so the decision to prescribe is more nuanced - depends on emmetropisation trajectory, combination of cyl/sphere, VA, parental attitude and sometimes just gut feeling'. 'If there is anisometropia and vision is reduced in the eye with high refractive error, I prescribe the full difference. I never prescribe the full myopic or hyperopic prescription to both eyes at the first visit for a child between 1 and 2 years of age'.	Agreement was obtained on the level of refractive error that should warrant prescribing; however, prescribing astigmatic correction in full or a hyperopic prescription was deemed inappropriate.
1–2 years: Constant esotropia	'Depends on the effect of proposed Rx on the cover test result, and at this age stereoacuity'. 'I would give full prescription to help alleviate any accommodation esotropia'. 'Full plus in esotropia regardless of age'.	Consensus obtained that giving full hyperopic ≥ +2.00 DS prescription was appropriate, and a modified prescription would be inappropriate.

(Continues)

TABLE 6 (Continued)

Scenario	Sample quotes	Comments
2–3 years: Vision reduced	'Would prescribe hyperopia over 3.5 D'. 'Generally, at this age, I would give what they need. If emmetropisation is going to happen or is mainly over, if they still have a refractive error, give the full prescription because if they haven't emmetropised by now, they probably won't'. 'If vision is reduced in a three year old with no strabismus, I prescribe full for a hyperope and under correct a myope. I do not reduce the prescription by half but reduce it by a dioptre. In my experience this allows the child to adapt to the prescription. I can always increase the prescription to full if vision does not come up'.	Agreement reached that prescribing the full hyperopic and astigmatic prescription is appropriate.
2–3 years: Vision reduced and anisometropia, with criterion level ≥ anisometropia to be corrected	'When there is difference between the eyes and vision is reduced, I try to prescribe the full in a 3 year old'. 'Again, it depends if pure cyl or with additional sphere, but if I decide to give glasses, then why not the full correction, because emmetropisation is not really an issue by this age'.	Agreement reached that prescribing the full refractive error was appropriate.
2–3 years: Constant esotropia	'Depends on how much plus and its effect on cover test and stereo'. 'Full plus in the presence of SOT [esotropia]'. 'Always try full plus. With small errors, abandon if they do not achieve control and VA is good'.	Agreement obtained that prescribing full hyperopia of ≥ +1.50 DS is appropriate, and a modified prescription is inappropriate.
3–4 years: Vision reduced	'Why give them an under-correction? Emmetropisation will have happened (so not an issue), or not (and probably won't), why leave them with blurred VA?' 'I would reduce the prescription by 0.50–1.00 D depending on the level of refractive error and the level of reduction of vision. If vision is reduced a lot, I would prescribe the full'.	Agreement reached for prescribing astigmatic prescription in full being appropriate. However, prescribing the full hyperopic prescription was agreed to be inappropriate.
3–4 years: Vision reduced and anisometropia, with criterion level ≥ anisometropia to be corrected	'If the child needs glasses, at this age, I don't see the point of partial corrections'. 'If it is in the eye with the high refractive error, I would give the full prescription. If the anisometropia is very high, I would under correct to avoid image size disparity. Give a maximum difference of up to 4.00 dioptres. If it is anymore, I discuss contact lens'.	Agreement reached on prescribing statements with consensus on prescribing hyperopia and astigmatism in full.
3–4 years: Constant esotropia	'Esotropia—always give full plus'. 'In a child with esotropia, I might consider prescribing a full prescription to see if this would help. I would not give a partial correction'.	Agreement reached that full hyperopic prescription of ≥+1.50 DS is appropriate and modifying the prescription is inappropriate.

levels of vision, parental preferences and the impact of socio-economic factors, which play a pivotal role in clinical decision making. These nuanced considerations, which may vary among experts, contributed to the non-consensus outcomes. Additionally, it is crucial to acknowledge that the field of paediatric optometry has evolved since the development of the AAO PPP guidelines.[37] Changes in practice patterns, advances in clinical skills and emerging evidence over time may have influenced the expert panel's perspectives. As our understanding of paediatric eye care continues to evolve, incorporating these dynamic elements becomes integral in refining recommendations. In summary, the rejection or non-consensus on certain recommendations was not solely attributable to the level of evidence or strength of recommendations provided by the AAO PPP guidelines. Instead, it reflected the complexity of paediatric vision care, encompassing a range of considerations that extend beyond the guidelines' scope.

The present Delphi study findings highlight instances of expert agreement on the levels of isometropia and anisometropic myopia, hyperopia and astigmatism that should be corrected in children less than 1 year, 1–2 years, 2–3 years and 3–4 years of age (Tables 2–5). These results also provide expert opinion on whether a modified or a full prescription should be considered. The findings also indicate the prescribing approach for a child in each of these age ranges with a constant esotropia (Table 7). Our findings show consensus that for isometropic refractive error, lower levels of hyperopic refractive errors are typically prescribed as children age, likely linked to emmetropisation.[20] The level at which a hyperopic prescription would be issued was consistent for children under 1 year and those aged 1–2 years, with slightly lower levels noted for 3- to 4-year-olds. Notably, lower levels of hyperopia are prescribed in children with constant esotropia compared to cases where there were no visual concerns. Moreover, clinicians are more inclined to prescribe the full hyperopic correction if there is a constant esotropia or if a child's vision is reduced. Regarding the type of refractive error, higher levels of bilateral hyperopia are generally required before clinicians consider prescribing, followed by myopia and astigmatism. It is worth noting that smaller degrees of anisometropia are typically prescribed for all types of refractive errors as children age.

TABLE 7 A summary table of prescribing recommendations (minimum refractive error to prescribe by age group, as stated in Paediatric Eye Evaluations PPP) based on expert panel consensus.

	Age (years)											
	<1 years			1–2 years			2–3 years			3–4 years		
	No visual concerns	Vision reduced	Constant esotropia	No visual concerns	Vision reduced	Constant esotropia	No visual concerns	Vision reduced	Constant esotropia	No visual concerns	Vision reduced	Constant esotropia
Isometropia												
Hyperopia			≥+2.00 DS (F)	≥+5.00 DS (M)	≥+5.00 DS (M/F)	≥+2.00 DS (F)	≥+4.50 DS (M/F)	≥+4.50 DS (F)	≥+1.50 DS (F)	≥+3.50 DS (M)		≥+1.50 DS (F)
Myopia				≥−4.00 DS (M)	≥−2.00 DS (F) ≥−4.00 DS (M)		≥−3.00 DS (F)	≥−3.00 DS (F)		≥− 2.50 DS (M/F)	≥−2.50 DS (F)	
Astigmatism: Oblique		≥−3.00 DC (F)		≥−2.50 DC (M)			≥−2.00 DC (M/F)	≥−2.00 DC (F)		≥−1.50 DC (M/F)	≥−1.50 DC (F)	
Astigmatism: Not oblique	≥−3.00 DC (M)			≥−2.50 DC (M)				≥−2.00 DC (F)		≥−1.50 DC (M/F)	≥−1.50 DC (F)	
Anisometropia												
Hyperopia	≥+2.50 DS (M/F)	≥+2.50 DS (M/F)		≥+2.00 DS (M/F)	≥+2.00 DS (M/F)		≥+1.50 DS (F)	≥+1.50 DS (F)		≥+1.50 DS (M)	≥+1.50 DS (M/F)	
Myopia	≥−4.00 DS (M/F)	≥−4.00 DS (M/F)		≥−3.00 DS (M/F)	≥−3.00 DS (M/F)		≥−3.00 DS (F)	≥−3.00 DS (F)		≥−2.50 DS (M/F)	≥−2.50 DS (M/F)	
Astigmatism: Oblique	≥−2.50 DC (M/F)	≥−2.50 DC (M/F)		≥−2.00 DC (M/F)	≥−2.00 DC (M/F)		≥−2.00 DC (F)	≥−2.00 DC (F)		≥−1.50 DC (M/F)	≥−1.50 DC (M/F)	
Astigmatism: Not oblique		≥−2.50 DC (M/F)		≥−2.00 DC (M/F)	≥−2.00 DC (M/F)		≥−2.00 DC (M/F)	≥−2.00 DC (M/F)		≥−1.50 DC (M/F)	≥−1.50 DC (M/F)	

Note: DC, dioptre cylinder; DS, dioptre sphere; F, Full prescription; M, Modified prescription. Grey cells = no expert consensus.

Additionally, there seems to be no distinction in prescribing recommendations between oblique and non-oblique astigmatism in the context of anisometropia, except for cases involving children under 1 year of age. Moreover, it is apparent from the data that the threshold for prescribing anisometropic hyperopia and type of astigmatism is roughly similar, whereas the threshold for anisometropic myopia tends to be higher. That being said, if a child has reduced vision in anisometropia, these findings suggest that this generally does not alter prescribing recommendations, except for oblique astigmatism in children under 1 year of age. The present findings also suggest a discrepancy in the approach to prescribing among practitioners, with some opting for modified and others for full prescriptions. This is consistent with previous findings.[20] The gaps in Table 7 indicate lack of agreement or indeed indicate no desire to prescribe, and therefore highlight issues that need to be addressed in further work.

Furthermore, the expert panel members had the opportunity to add comments to justify their responses to each prescribing statement. The sample quotes in Table 6 illustrate the variation in approaches and demonstrate a need for paediatric refractive prescribing guidelines to be produced to aid decision making across different clinical scenarios. For example, for the <1 year age group with no visual concerns or with reduced vision (in the absence of strabismus), the comments from the expert panel members indicated that they would only prescribe if there was a very high refractive error. For high myopic prescriptions in children <1 year, panel members indicated that the prescription should be reduced by '2 dioptres', but we did not find consensus on the level at which it would be appropriate to prescribe.[73] However, it should be noted that as well as the level of refractive error, a range of other factors such as vision, cover test results and family ocular history should also be considered when prescribing for refractive error correction.[21] For example, when managing myopic children, a modified or full correction may be prescribed depending on the degree of myopia and the child's family ocular history, parents' attitude towards spectacles and the practitioners' preference and prior experience. A discussion of these is beyond the scope of this research but should be considered in further studies, and more information is required to understand the rationale behind practitioners' clinical decision making when prescribing a refractive error correction.[24] Our findings indicate a need for comprehensive, evidence-based resources to help practitioners decide when and how to prescribe refractive error correction in children.[19–21]

It has been acknowledged that the sampling methods employed to select and form the expert panel may have led to selection bias. However, efforts to minimise bias were made by ensuring the expert panel consisted of a multidisciplinary team of experienced professionals in working with children, and all members had extensive experience in paediatric eye care. While the wide range of paediatric experience of the panel members was a strength, a limitation was the range of experience with younger children; for example, one panellist had no experience in working with children <12 months of age. In addition, it should be noted that while this study was aimed at optometrists, we included orthoptists in the panel. This is because practicing registered orthoptists routinely work with children, and despite orthoptists not being able to prescribe at present, the refractive findings when combined with the clinical findings help facilitate management plans for young children.

It should be noted that the Delphi study was based on the Pediatric Eye Evaluations Preferred Practice Pattern® (American Academy of Ophthalmology).[36] These guidelines were updated in 2023.[37] Nonetheless, findings from this study still broadly align with the more recently published guidelines for refractive correction in young children derived by expert consensus.[37] The main difference in findings are the prescribing recommendations in Table 7, which indicate where a full or modified refractive error should be considered. Further research is required to help format and build evidence-based guidelines with high methodological quality for professionals to use when prescribing refractive error correction in children. These guidelines would ensure alignment across professions, providing guidelines for use together with clinical discretion when managing children. Adding information regarding prescribing a refractive correction during myopia control would be beneficial and would aid those practitioners involved in myopia management.

CONCLUSION

The application of the AGREE II instrument has demonstrated variability in the quality of current refractive error correction guidelines and highlighted several key areas that require improvement. By using the modified Delphi technique to obtain expert opinion and gain consensus on prescribing for children based on statements extracted from a high-quality guideline, we have provided a set of agreed prescribing recommendations. Our findings suggest that the currently available prescribing guidelines for refractive errors in children require further work and improvement, including further consultation with relevant stakeholders to enable practitioners to make consistent evidence-based decisions.

AUTHOR CONTRIBUTIONS

Salma Wilson: Conceptualization (equal); data curation (lead); formal analysis (equal); investigation (lead); methodology (equal); writing – original draft (equal); writing – review and editing (equal). **Catherine Suttle:** Conceptualization (equal); formal analysis (equal); investigation (equal); methodology (equal); supervision (equal); writing – original draft (equal); writing – review and editing (equal). **Rakhee Shah:** Conceptualization (equal); formal analysis (equal); methodology (equal); supervision (equal); writing – original draft (equal); writing – review and editing (equal). **Miriam Conway:** Conceptualization (equal); formal analysis (equal); methodology (equal); supervision (equal); supervision (equal); writing – original draft (equal); writing – original draft

(equal); writing – review and editing (equal); writing – review and editing (equal). **Irene Ctori:** Conceptualization (equal); formal analysis (equal); investigation (equal); methodology (equal); supervision (lead); writing – original draft (equal); writing – review and editing (equal).

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CONFLICT OF INTEREST STATEMENT

The authors report no conflicts of interest and have no proprietary interest in any of the materials mentioned in this article.

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APPENDIX 1

Keywords used during electronic database searches

OR (any of the following terms)	OR (any of the following terms)	OR (any of the following terms)	OR (any of the following terms)	AND (a combination term from the OR columns)
Refractive error	Guideline's recommendations specification standard, criterion protocol	Prescribing	Child*	
Ametropia spectacle			Infant*	
Prescription glasses prescription			Newborn	
			Pediatric*	
			Minors	
			Preschool	

* indicates where truncation was allowed/used in the search term.

APPENDIX 2

PRISMA guidelines followed during the search and appraisal.

Section and topic	Item #	Checklist item	Location where item is reported
Title			
Title	1	Identify the report as a systematic review.	
Abstract			
Abstract	2	See the PRISMA 2020 for abstracts checklist.	
Introduction			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	
Methods			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g., for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	
	10b	List and define all other variables for which data were sought (e.g., participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	

APPENDIX 2 (Continued)

Section and topic	Item #	Checklist item	Location where item is reported
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	
Effect measures	12	Specify for each outcome the effect measure(s) (e.g., risk ratio, mean difference) used in the synthesis or presentation of results.	
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis [e.g., tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)].	
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity and software package(s) used.	
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g., sub-group analysis, meta-regression).	
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	
Results			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	
Study characteristics	17	Cite each included study and present its characteristics.	
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g., confidence/credible interval), ideally using structured tables or plots.	
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g., confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	

APPENDIX 2 (Continued)

Section and topic	Item #	Checklist item	Location where item is reported
Discussion			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	
	23b	Discuss any limitations of the evidence included in the review.	
	23c	Discuss any limitations of the review processes used.	
	23d	Discuss implications of the results for practice, policy and future research.	
Other Information			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	
Competing interests	26	Declare any competing interests of review authors.	
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	

From: Page et al.[74]

APPENDIX 3

Demographic characteristics of the expert panel members from the United Kingdom.

Demographic characteristics	Frequency (*n*)	%
Profession		
Optometrist	6	60
Ophthalmologist	2	20
Orthoptist	2	20
Number of years of experience in paediatric eye care		
0–15 years	4	40
16–31 years	5	50
32–47 years	1	10
Work setting		
Hospital	7	35
Community practice (multiple)	2	10
Community practice (independent)	3	15
Academia	4	20
Research	3	15
Domiciliary	1	5
Experience examining children		
Extensive experience with a child who is <12 months old	4	40
Good experience with a child who is <12 months old	1	10
Some experience with a child who is <12 months old	1	10
Little experience with a child who is <12 months old	3	30
No experience with a child who is <12 months old	1	10
Extensive experience with a child who is 12–24 months old	4	40
Good experience with a child who is 12–24 months old	1	10
Some experience with a child who is 12–24 months old	4	40
Little experience with a child who is 12–24 months old	0	0
No experience with a child who is 12–24 months old	1	10
Extensive experience with a child who is 2–4 years of age	4	40
Good experience with a child who is 2–4 years	3	30
Some experience with a child who is 2–4 years	2	20
Little experience with a child who is 2–4 years	1	10
No experience with a child who is 2–4 years	0	0
Extensive experience with a child who is 5–7 years	6	60
Good experience with a child who is 5–7 years	4	40
Some experience with a child who is 5–7 years	0	0
Little experience with a child who is 5–7 years	0	0
No experience with a child who is 5–7 years	0	0
Extensive experience with a child who is 8–11 years	6	60
Good experience with a child who is 8–11 years	3	30
Some experience with a child who is 8–11 years	1	10
Little experience with a child who is 8–11 years	0	0
No experience with a child who is –11 years	0	0
Extensive experience with a child who is 12 years of age and over	6	60
Good experience with a child who is 12 years of age and over	3	30
Some experience with a child who is 12 years of age and over	1	10

APPENDIX 3 (Continued)

Demographic characteristics	Frequency (*n*)	%
Little experience with a child who is 12 years of age and over	0	0
No experience with a child who us 12 years of age and over	0	0
Resources used during the clinical decision making		
Education from university	9	14.1
Pre-registration training and experience	6	9.4
Clinical guidelines	7	10.9
Continuing education training (CET)/customisable professional development (CPD) courses	5	7.8
Opinions from lead professionals	10	15.6
Evidence-based literature	8	12.5
Patient feedback on adaptation	9	14.1
Clinical experience	10	15.6