

Review Article

Dropout rates among optical interventions for myopia control: a systematic review

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ABSTRACT

Background: Understanding adherence and discontinuation is essential for evaluating the real-world feasibility of myopia-control strategies. Although dropout is recognised as a concern in adult contact lens wear, its prevalence and causes in paediatric optical myopia-control interventions remain poorly characterised. This study systematically quantified dropout rates and examined reasons for discontinuation across optical modalities used for myopia control in children.

Methods: A systematic review was conducted in accordance with PRISMA and registered in PROSPERO (CRD420251177073). PubMed, Scopus, and Web of Science were searched through April 2025, supplemented by reference screening. Randomised and non-randomised clinical trials enrolling children and adolescents (≤ 18 years) and reporting discontinuations during optical myopia-control treatment were included. Data on study design, subject characteristics, dropout counts, subject-years, and reasons for discontinuation were extracted. Poisson regression with log-link and offset for subject-years estimated dropout rates with 95 % confidence intervals; Bonferroni-adjusted pairwise contrasts compared modalities.

Results: Fifty-seven trials met inclusion criteria (22 spectacles, 20 soft contact lenses, 17 orthokeratology), representing $> 7,000$ subject-years. Dropout ranged from 6 % to 21 % per year across modalities ($p < 0.001$), lowest for spectacles and highest for soft contact lenses. Reasons for dropout also differed significantly between modalities ($p < 0.001$). Spectacles showed markedly lower discontinuation due to “symptoms, vision, appearance, fitting/handling issues” and “unknown” reasons (both $p < 0.05$) but higher dropout for administrative/logistical “other” reasons versus contact lenses ($p < 0.03$). Soft contact lenses had lower discontinuation for “ocular adverse events” than orthokeratology but substantially higher discontinuation for “unknown” reasons ($p < 0.001$). No significant differences were found between modalities for treatment/compliance or non-ocular health reasons ($p > 0.05$).

Conclusions: Dropout in paediatric optical myopia-control interventions is modality-dependent, reflecting differences in handling burden, ocular tolerance, and follow-up demands. Standardised reporting of discontinuation reasons and structured adherence-support strategies are required to improve comparability across studies, enhance patient retention, and optimise real-world myopia-control outcomes.

1. Introduction

Myopia has emerged as a global public health concern, with prevalence increasing rapidly in both developed and developing regions. Recent projections estimate that by 2050, nearly half of the world's population will be myopic, and close to one billion individuals will develop high myopia, [1] placing them at risk for vision-threatening complications such as retinal detachment, myopic maculopathy, and

glaucoma [2].

Consequently, the clinical management of myopia has shifted from simple refractive correction to active myopia control strategies aimed at slowing the progression of myopia and reducing long-term ocular morbidity [3–5].

A wide range of optical interventions, including spectacle and soft contact lenses specifically designed for slowing myopia progression, as well as overnight orthokeratology have gained traction as effective

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myopia control options [6,7]. Across these modalities, the primary focus of clinical research has been efficacy in slowing refractive error progression and axial elongation [8]. However, efficacy is only one dimension of successful myopia control treatment [9]. Compliance directly impacts efficacy regardless of the modality and is the most important consideration, as it is influenced by factors such as quality of vision and comfort. Equally important for translation to real-world practice is treatment acceptability, safety, and the capacity of children and families to adhere to and persist with prescribed therapy over extended periods. Thus, subject compliance with the treatment schedule is important when assessing the effectiveness of a treatment option as high discontinuation rates might suggest that the treatment is unlikely to be successful, irrespective of its clinical outcome.

Dropout—the permanent discontinuation of an intervention before study completion—serves as a pragmatic indicator of treatment feasibility. Some discontinuations arise from adverse ocular events, discomfort, or handling difficulties that directly reflect limitations of the intervention itself. Others, such as relocation, protocol changes, or loss of motivation, reflect contextual and behavioural barriers to sustained adherence. High dropout rates not only threaten the internal validity of clinical trials but also reduce the generalizability of efficacy outcomes, as participants who remain may differ systematically from those who discontinue or from their comparison groups, leading to biased estimates. In clinical practice, dropout equates to treatment abandonment, which may undermine broader public health efforts to reduce the burden of myopia progression.

Despite its importance, dropout has received little attention in the myopia control literature. Previous research has highlighted non-adherence and discomfort as key challenges in sustaining contact lens wear among children undergoing myopia control. It has been reported that up to one-third of paediatric contact lens wearers were non-adherent, primarily due to reduced comfort and vision satisfaction, often leading to treatment discontinuation [10]. Yet, comparative evidence on dropout patterns across optical modalities remains scarce, underscoring the need to identify modality-specific factors contributing to discontinuation in myopia-control interventions. Furthermore, published studies often report crude numbers of discontinuations or classify them broadly as “lost to follow-up,” without detailed analysis of incidence rates or reasons. Moreover, dropout is variably influenced by study duration, sample size, and intervention type, complicating direct comparisons between modalities. Normalized dropout against exposure time is essential for making fair cross-study comparisons, given the longitudinal nature of myopia control interventions.

A nuanced understanding of dropout is particularly relevant when comparing spectacle-based versus contact lens-based interventions [11,12]. Spectacle lenses are non-invasive and familiar to families, potentially enhancing compliance, yet may be perceived cosmetically unattractive by children. In contrast, contact lenses often improve how children and teenagers feel about their appearance and participation in activities, leading to greater satisfaction with their refractive error correction, but require greater handling skills, daily motivation, and tolerance of ocular symptoms [12–14]. A further benefit of overnight orthokeratology is the elimination of a need for optical correction during the day. These factors may increase the likelihood of dropout due to symptoms, compliance issues, or adverse events. Clarifying whether specific modalities are more prone to dropout, and identifying the predominant reasons, is therefore vital for clinicians counselling families on treatment choice, and for researchers designing interventions that balance efficacy with long-term usability.

The present systematic review addresses this gap by synthesizing dropout data from clinical trials of spectacles, soft contact lenses, and orthokeratology for paediatric myopia control. By focusing on dropout as an outcome of interest, this review extends beyond conventional measures of efficacy. It highlights the practical realities of implementing myopia control in children and provides clinicians, researchers, and policymakers with critical insights into intervention sustainability.

Ultimately, understanding dropout rates and reasons will help refine patient selection, improve adherence support, and guide innovation in optical designs to enhance long-term treatment success.

2. Methods

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines [15,16] and was registered in PROSPERO (CRD420251177073). The study selection process adhered to the PRISMA flow diagram (Fig. 1).

2.1. Literature search

A comprehensive search was performed in PubMed, Scopus, and Web of Science from inception to 7 April 2025, using controlled vocabulary and free-text terms related to myopia control and optical modalities (“myopia control” OR “myopia progression” AND “spectacles” OR “soft contact lenses” OR “orthokeratology”). Two independent reviewers screened titles, abstracts, and full texts according to predefined eligibility criteria, with disagreements resolved by consensus or a third reviewer. Reference lists of included articles and relevant reviews were also examined to ensure completeness.

2.2. Eligibility criteria

Studies were selected according to the ‘PICOS’ framework (Population, Intervention, Comparison, Outcome, Study design):

- Population: Myopic children and adolescents aged ≤ 18 years.
- Intervention: Optical interventions for myopia control, including spectacles, soft contact lenses, or overnight orthokeratology.
- Comparison: Age-, sex-, and refractive error-matched control groups.
- Outcomes: Change in spherical equivalent refractive error and/or axial length between intervention and control groups.
- Study design: Randomized controlled trials, prospective longitudinal studies, or historical-control designs with ≥ 1 year of follow-up.

Most trials were prospective, parallel, and controlled. Historical-control studies contributed intervention-arm data only. For crossover studies, data from the first phase (before crossover) were used if follow-up was at least one year. In extended studies where controls were later offered the experimental treatment, only data from the original trial phase were analysed. Retrospective, contralateral-eye, and non-inferiority designs were excluded. Only English-language publications were included.

2.3. Data extraction

From each included study, the following information was extracted:

- Study characteristics: first author, year of publication, and study design.
- Participant characteristics: sample size at enrolment, mean \pm standard deviation (SD) or median [quartile 1(Q1)–quartile 3(Q3)] age, and subjects’ ethnicity.
- Intervention details: type of optical device used in the intervention and control groups, and study duration.
- Outcomes related to discontinuation: number of participants who discontinued and the reported reasons for discontinuation.

2.4. Data analysis

To account for variable follow-up durations, dropout rates were standardized per 100 patient-years of lens wear, calculated as (total number of dropouts \div subject-years of wear) \times 100. Discontinuations

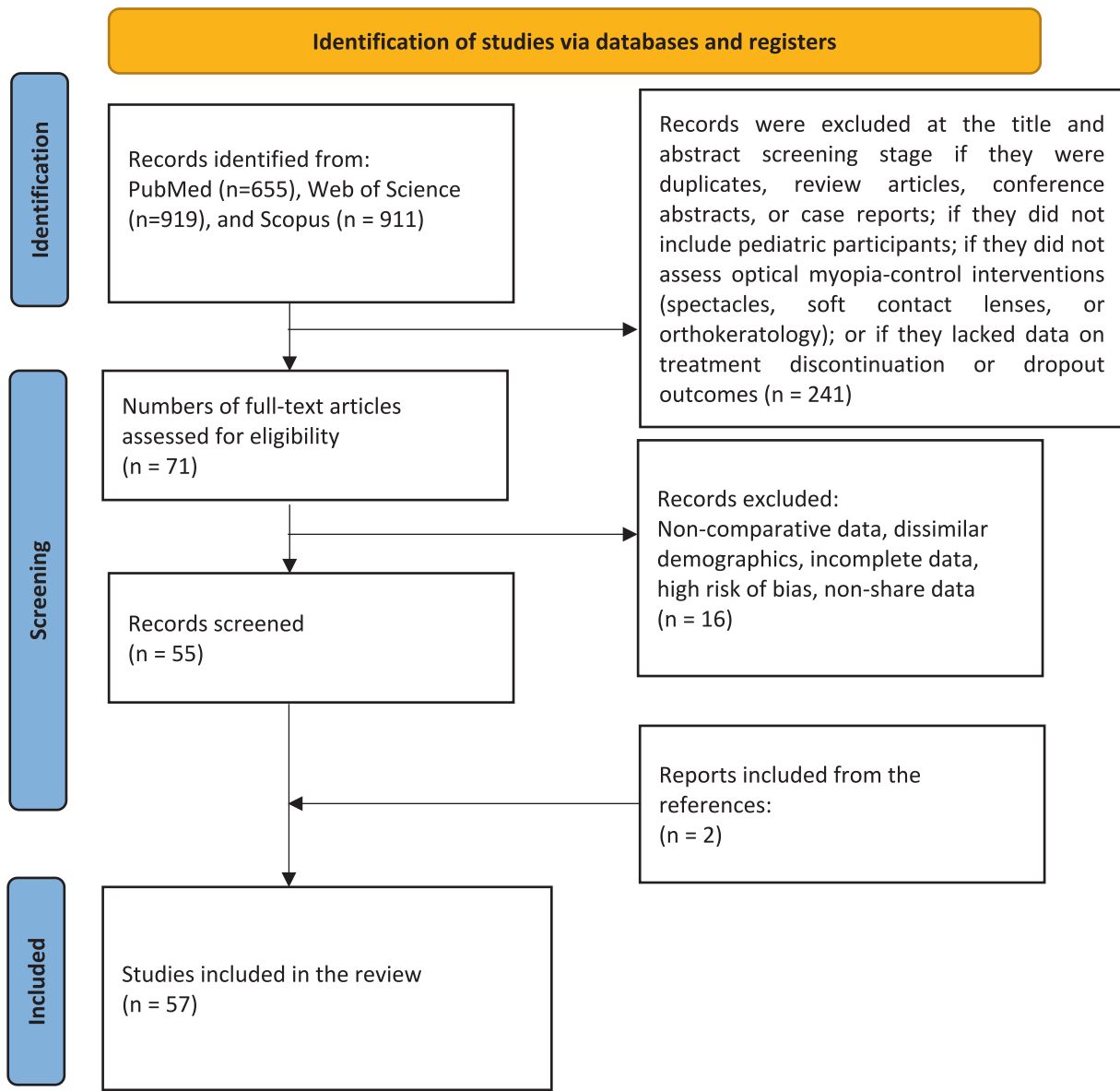


Fig. 1. PRISMA flow diagram of study selection.

occurring before treatment initiation (e.g., withdrawal at baseline before commencing wear) were not considered true dropouts; where studies distinguished pre-initiation withdrawals from post-initiation discontinuations, only the latter were classified as dropouts. Timing of discontinuation was not consistently reported across studies. Accordingly, subject-years were derived from subjects reported to have completed follow-up, and no partial exposure time was assigned to subjects who permanently discontinued. This decision avoided introducing assumptions about dropout timing but may overestimate dropout incidence when discontinuations occur after non-trivial exposure. Ninety-five percent confidence intervals (CIs) for crude dropout rates were calculated using Wilson’s method [17]. Dropout reasons were harmonized across studies and classified into six categories (Table 1). The ‘symptoms, vision, appearance, and lens fitting and handling issues’ category was intentionally defined as a composite because primary studies frequently reported these drivers jointly (e.g., ‘discomfort/poor vision/handling’) or without sufficient detail to separate them reliably. Where studies explicitly distinguished subcomponents, they were retained in the extracted dataset (Appendix Tables S1–S3) but mapped to the composite category for cross-study comparability.

2.5. Statistical analysis

Dropout rates were analysed using Poisson regression models with a log link, specifying the number of discontinuations as the dependent variable and the natural logarithm of subject-years as an offset term. Analyses were performed at two levels:

1. Within each optical modality (spectacles, soft contact lenses, orthokeratology), comparing intervention and control arms.
2. Across modalities, using modality as the independent factor, with pairwise contrasts to assess differences in overall dropout rates.

For analyses of specific reasons for discontinuation (six-category variable; Table 1), predictors included group (intervention vs control), optical modality, and their interaction. When comparing across modalities, predictors included dropout category, modality, and their interaction. These models produced estimated marginal means and pairwise contrasts expressed on the response scale (dropout rate per 100 subject-years), enabling direct interpretation of absolute rate differences.

Table 1
Classification of dropout reasons into six major categories.

Dropout reason category	Includes
<i>Symptoms, vision, appearance, and lens fitting/handling issues</i>	Discomfort, blurred or unsatisfactory vision, cosmetic concerns, and issues with lens fitting, insertion, removal, or general handling difficulties.
<i>Ocular adverse events and complications</i>	Any reported ocular complication or adverse event, including corneal staining, infiltrates, keratitis, conjunctivitis, corneal abrasion, or other lens-related ocular pathology.
<i>Treatment and compliance issues</i>	Issues related to adherence to treatment, including lack of motivation, unwillingness to wear lenses or attend follow-up visits, protocol non-compliance, and switching to other myopia control or non-myopia control lens modalities.
<i>Non-ocular health issues</i>	General or systemic health problems unrelated to ocular status (e.g., systemic illness, medical conditions, or death unrelated to study intervention).
<i>Others</i>	Reported discontinuations that do not clearly align with any of the preceding categories, including administrative or logistical reasons (e.g., relocation, change of address, scheduling conflicts, or study withdrawal due to personal or family circumstances).
<i>Unknown</i>	Reasons not reported, or reported generically as lost to follow-up, withdrawal/withdrew consent, or other unspecified withdrawal.

For comparisons across modalities, incidence rate ratios (IRRs) and corresponding 95 % confidence intervals (CIs) were obtained by exponentiating the Poisson model coefficients and their standard errors, providing relative measures of difference in dropout rates. Models were adjusted for exposure time using subject-years as an offset. An IRR of 1.0 indicated equal dropout rates between modalities, values > 1.0 indicated higher dropout in the numerator modality, and values < 1.0 indicated lower dropout.

All analyses were performed in JASP (version 0.19.1, University of Amsterdam, The Netherlands) using the Generalized Linear Models module with a Poisson distribution and log link. Statistical significance was set at $p < 0.05$, and Bonferroni adjustments were applied to pairwise comparisons.

3. Results

After screening and eligibility assessment, 57 studies met the inclusion criteria and were included in the quantitative synthesis (Fig. 1). Of these, 22 evaluated spectacle-based interventions, 20 evaluated soft contact lenses, and 17 evaluated orthokeratology lenses (Appendix A Supplementary data: Tables S1–S3). These studies encompassed a broad range of ethnic populations, with participants recruited from eleven countries: the People's Republic of China, the United States, Japan, Canada, Italy, Israel, Spain, Malaysia, Taiwan, Denmark, and India. In total, 1,262 discontinuations were identified, comprising 353 cases in the spectacles group, 626 in the soft contact lens group, and 442 in the orthokeratology group, with 822 occurring in intervention arms and 440 in control arms. Collectively, they included children and adolescents aged 5 to 18 years and contributed data representing more than 7,000 subject-years of lens wear.

3.1. Dropout rates

Dropout rates differed between intervention and control groups for all three optical modalities (Fig. 2). For spectacle-based interventions, dropout rates were 6.1 per 100 subject-years in the intervention group and 5.6 per 100 subject-years in controls, yielding no significant difference between groups ($p = 0.417$). In contrast, soft contact lens interventions showed significantly higher dropout than controls (21.3 vs 14.8 per 100 subject-years; $p < 0.001$). Conversely, orthokeratology interventions had significantly lower dropout compared with controls (13.9 vs 21.3 per 100 subject-years; $p < 0.001$).

Significant differences in dropout rates were also found between the three main optical interventions ($p < 0.001$) (Fig. 2). Specifically, dropout in spectacles was approximately 71 % lower than in soft contact lenses (IRR = 0.29, 95 % CI: 0.24–0.34, $p < 0.001$) and 56 % lower than in orthokeratology (IRR = 0.44, 95 % CI: 0.36–0.54, $p < 0.001$). Dropout was also significantly higher for soft contact lenses than orthokeratology, with children being about 1.5 times more likely to discontinue soft contact lenses than orthokeratology (IRR = 1.53, 95 % CI: 1.29–1.82, $p < 0.001$).

3.2. Dropout reasons

Across all modalities and both intervention and control arms, most discontinuations were classified as “unknown”—encompassing loss to

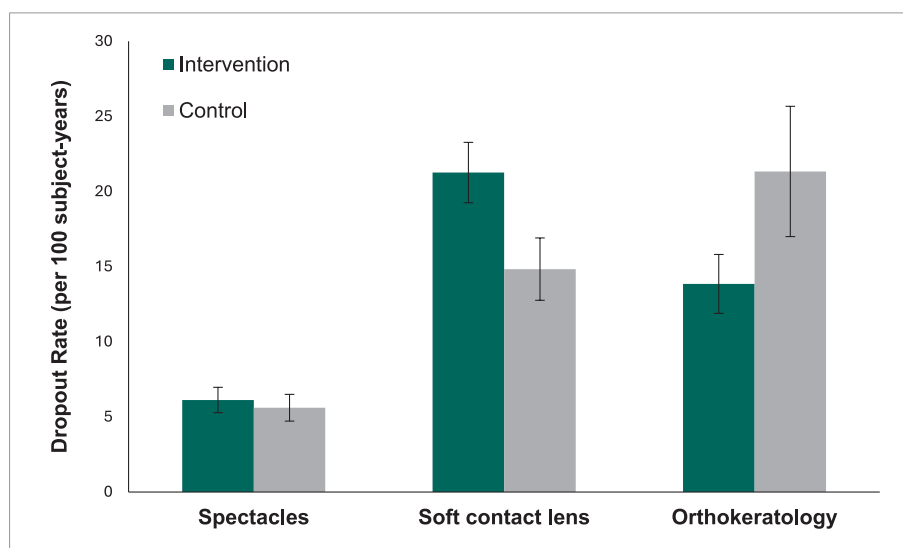


Fig. 2. Dropout rates (per 100 subject-years of lens wear) for intervention and control groups across the three optical modalities. Error bars represent 95% confidence intervals calculated using Poisson models adjusted for exposure time.

follow-up or cases where reasons were not reported—followed by “treatment and compliance issues”, which included unwillingness or refusal to wear lenses, disinterest or loss of motivation, poor compliance, and switching to alternative treatments, the latter frequently to a myopia control intervention among participants in the control arm.

The distribution of dropout reasons differed significantly between the intervention and control arms for all three optical modalities (all $p < 0.001$) (Fig. 3). For spectacle lenses, the intervention arm showed a higher rate for “other” reasons than the control arm ($p = 0.004$). For soft contact lenses, the intervention arm had a higher dropout rate for “unknown” reasons than control ($p < 0.001$). In orthokeratology, the intervention arm had a higher rate of “ocular adverse events and complications” than control ($p < 0.001$). None of the remaining dropout reason categories showed statistically significant differences between intervention and control groups across the three optical modalities (all $p > 0.05$).

The distribution of dropout reasons also differed significantly between the three optical interventions (all $p < 0.001$) (Fig. 3). Spectacles versus soft contact lenses showed substantially lower discontinuation rates for “symptoms, vision, appearance, and fitting/handling issues” (0.27 [0.13–0.52] vs 1.34 [0.88–1.95]; IRR = 0.20, 95 % CI: 0.10–0.40; $p = 0.026$), representing an approximately 80 % lower rate compared with soft contact lenses, and for “unknown” reasons (2.92 [2.37–3.57] vs 15.41 [13.75–17.22]; IRR = 0.19, 95 % CI: 0.14–0.25; $p < 0.001$), an 81 % lower rate. Conversely, discontinuations for “other” reasons were about twice as high in the spectacle vs soft (1.49 [1.10–1.97] vs 0.74 [0.42–1.23]; IRR = 2.01, 95 % CI: 1.20–3.40; $p < 0.001$). Similarly, spectacles versus orthokeratology showed markedly lower discontinuation due to “symptoms, vision, appearance, fitting/handling issues” (0.27 [0.13–0.52] vs 2.89 [2.06–3.93]; IRR = 0.09, 95 % CI: 0.05–0.20; $p < 0.001$), corresponding to a 91 % lower rate, and also lower dropout for “unknown” reasons (2.92 [2.37–3.57] vs 4.04 [3.05–5.25]; IRR = 0.72, 95 % CI: 0.50–1.05; $p = 0.008$), an approximate 28 % reduction. However, discontinuations for “other” reasons were around 70 % higher in spectacle vs orthokeratology (1.49 [1.10–1.97] vs 0.87 [0.45–1.51]; IRR = 1.71, 95 % CI: 1.00–2.90; $p < 0.001$). In contrast, soft contact lenses versus orthokeratology showed approximately 77 % lower discontinuation due to “ocular adverse events and complications” (0.59 [0.31–1.04] vs 2.60 [1.82–3.60]; IRR = 0.23, 95 % CI: 0.09–0.56; $p = 0.006$), but about 3.8-fold higher discontinuation for “unknown” reasons (15.41 [13.75–17.22] vs 4.04 [3.05–5.25]; IRR = 3.81, 95 % CI: 2.80–5.20; $p < 0.001$). No statistically significant differences were observed for “treatment and compliance issues” or “non-ocular health”

reasons across any pairwise comparison.

4. Discussion

Although dropout has long been recognized as a concern in adult contact lens wear, [18] evidence regarding discontinuation in paediatric optical myopia control remains limited. To address this gap, the present study represents, to the authors’ knowledge, the first systematic review to quantify and compare dropout rates and their underlying reasons across optical interventions—spectacles, soft contact lenses, and orthokeratology—used to slow myopia progression in children and adolescents. Despite good clinical trial practice includes systematic recording and reporting of dropout reasons, [19] this review revealed that such data are frequently incomplete or omitted in studies, restricting insight into adherence challenges.

Across optical modalities, dropout rates ranged from approximately 6 % to 21 % per year, indicating that discontinuation patterns are strongly modality-dependent and influenced by user burden, ocular tolerance, and adherence demands (Fig. 2). Spectacle-based treatments exhibited the lowest discontinuation rates, consistent with their simplicity and minimal ocular risk, whereas soft contact lenses demonstrated the highest dropout rates overall—likely driven by the behavioural and physiological demands of daily lens wear despite their proven safety and efficacy in slowing myopia progression [20,21]. Orthokeratology ranked between the two, showing better retention than soft contact lenses but somewhat higher discontinuation than spectacles, reflecting the greater adaptation requirements and potential for mild ocular events associated with overnight lens wear [22,23].

Differences in the distribution of dropout reasons between intervention and control groups, as well as across optical modalities, highlight the multifactorial nature of adherence in paediatric myopia control. In spectacle studies, the higher discontinuation rate for “other” reasons among intervention subjects likely reflected administrative or logistical circumstances—such as relocation, scheduling conflicts, or family-related constraints—rather than issues with the treatment itself. In soft contact lens trials, the greater proportion of withdrawals classified as “unknown” probably resulted from incomplete documentation rather than genuine differences in comfort or tolerability, underscoring the need for standardized reporting of discontinuation reasons in clinical research. For orthokeratology, higher dropout attributed to “ocular adverse events and complications” suggests that even mild, transient effects—such as corneal staining or discomfort—may influence parental or clinical decisions to discontinue treatment, despite their overall safety

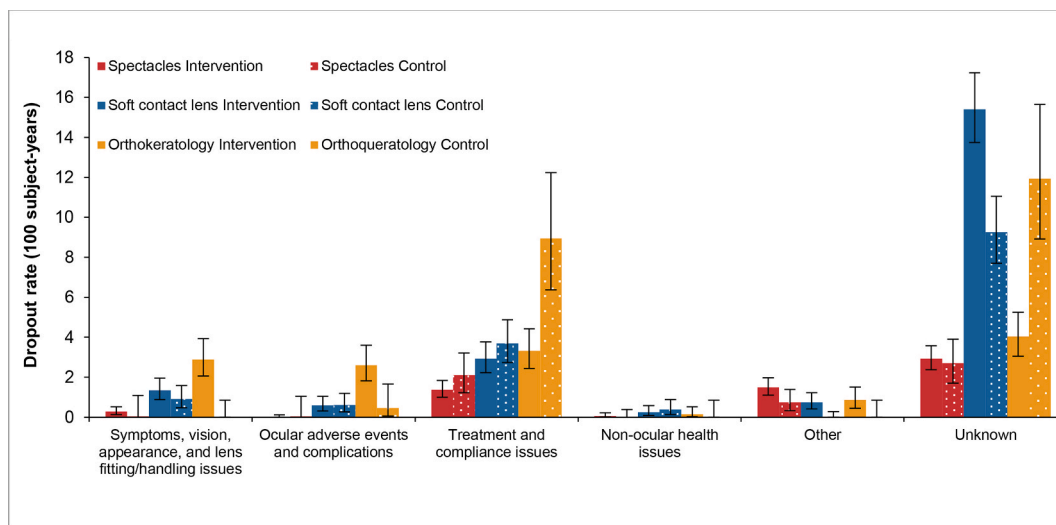


Fig. 3. Dropout reasons (per 100 subject-years) of lens wear for intervention and control groups across the three optical modalities. Bars represent estimated marginal means and error bars 95% confidence intervals from Poisson regression adjusted for exposure time with subject-years as offset.

and efficacy in slowing myopia progression [22,23].

Across modalities, spectacle wearers exhibited markedly lower discontinuation rates, particularly for “symptoms, vision, appearance, and fitting/handling issues” and for “unknown” reasons, consistent with their minimal adaptation requirements and lack of ocular surface contact. In contrast, higher dropout for these categories among contact lens wearers, especially orthokeratology users, likely reflects the greater handling complexity and initial adaptation demands inherent to lens wear. Meanwhile, the elevated discontinuation for “other” reasons across interventions underscores that non-clinical, contextual factors—such as logistical or administrative constraints—also play a meaningful role in study retention and treatment adherence.

Taken together, these findings indicate that adherence in paediatric myopia control is shaped by a combination of comfort, handling complexity, and contextual or behavioural factors, as well as by the quality of trial monitoring. While contact lens-based interventions—particularly soft contact lenses—offer proven myopia control benefits, they also pose greater challenges for sustained compliance and follow-up continuity compared with spectacles. Addressing handling and comfort barriers, enhancing parental engagement, and implementing standardized frameworks for classifying and reporting discontinuation reasons will be critical to improving retention and comparability across future myopia control studies.

The present results complement those of a previous study, [10] which reported that reduced comfort and visual satisfaction strongly predicted non-adherence to contact lens wear among children. The current analysis extends those observations by quantifying dropout rates and categorizing reasons for discontinuation across modalities, confirming that handling difficulty, visual dissatisfaction, and adherence issues are key determinants of attrition. These insights highlight the importance of individualized patient education, early follow-up, and ongoing comfort assessments to minimize discontinuation and preserve the clinical and research validity of myopia-control outcomes. Notably, interventions such as customized text message reminders have been shown to be feasible and effective in improving contact lens compliance, suggesting a practical strategy to enhance adherence in paediatric myopia-control programs [24].

This study has several limitations that should be acknowledged. The literature search was restricted to three databases and a limited set of key terms, which may have excluded some relevant publications. Timing of discontinuation was seldom reported; consequently, partial follow-up time accrued by subjects who discontinued could not be incorporated into the exposure denominator, which may inflate dropout incidence when discontinuations occurred late during follow-up. Analyses were based on aggregated rather than individual data, limiting control for confounders (e.g., age, baseline myopia, or lens material) and precluding robust stratification of dropout by sex or developmental stage. Definitions and reporting of dropout reasons were inconsistent and frequently incomplete across studies, contributing to a high proportion of discontinuations classified as “unknown”. Generalizability may be limited because many included trials were conducted under controlled conditions and predominantly in East Asian populations. Trial retention can differ from real-world persistence due to protocol-driven visit schedules, structured training and monitoring, and differences in cost coverage; these factors may either reduce dropout (support/monitoring) or increase dropout (visit burden). Given uneven representation of settings and populations across included trials, the estimates should be interpreted primarily as comparative patterns between modalities rather than a universal real-world benchmark. Despite these limitations, the inclusion of more than 7,000 subject-years of lens wear across three optical modalities provides useful comparative estimates of dropout rates and reported discontinuation reasons for optical myopia-control interventions.

In conclusion, across optical interventions for myopia control, dropout rates ranged from approximately 6 % to 21 % per 100 subject-years, with the lowest rates for spectacle interventions and the highest

for soft contact lenses, indicating that dropout patterns in paediatric myopia-control optical interventions are modality-dependent, influenced by user burden, ocular tolerance, and adherence demands. While spectacles remain the most acceptable in terms of continuation, orthokeratology appears to balance efficacy and adherence favourably, whereas soft contact lenses may face greater barriers to sustained use despite their proven safety and efficacy. These results underscore that dropout should be considered a critical outcome alongside safety and efficacy when selecting or prescribing optical interventions for myopia management. Future trials should routinely report timing of discontinuation, standardized discontinuation reasons, and retention stratified by sex and clinically meaningful age bands (e.g., early childhood, school-age, adolescents), and should incorporate adherence-support strategies and more diverse populations to better reflect real-world implementation. Understanding and addressing the factors contributing to discontinuation is essential for improving treatment adherence, optimizing clinical outcomes, and guiding the design of future myopia control studies.

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Declaration of generative AI in scientific writing: During the preparation of this work the author(s) used ChatGPT Plus, Version 1.2025.280 to support data analysis interpretation and academic writing. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.clae.2025.102601>.

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