



Contents lists available at ScienceDirect

## Contact Lens and Anterior Eye

journal homepage: [www.elsevier.com/locate/clae](http://www.elsevier.com/locate/clae)

## Comparison of vision-related quality of life between wearing Orthokeratology lenses and spectacles in myopic children living in Kuala Lumpur

Bariah Mohd-Ali<sup>a,\*</sup>, Yu Chen Low<sup>a</sup>, Mizhanim Mohamad Shahimin<sup>a</sup>, Norlaili Arif<sup>a</sup>, Hamzaini Abdul-Hamid<sup>b</sup>, Wan Haslina Wan Abdul-Halim<sup>c</sup>, Norhani Mohidin<sup>d</sup>

<sup>a</sup> Optometry and Vision Science Program & Research Centre for Community Health (REACH), Faculty of Health Sciences, Universiti Kebangsaan, Malaysia

<sup>b</sup> Department of Radiology, Faculty of Medicine, Universiti Kebangsaan, Malaysia

<sup>c</sup> Department of Ophthalmology, Faculty of Medicine, Universiti Kebangsaan, Malaysia

<sup>d</sup> Optometry Centre, Faculty of Health Science, Universiti Teknologi MARA

## ARTICLE INFO

## Keywords:

Orthokeratology  
Myopia  
Children  
Quality of life

## ABSTRACT

**Purpose:** There are limited reports available on the impact of wearing Orthokeratology (ortho-K) lenses on the quality of life of Asian children. This study evaluated and compared vision-related quality of life (VRQoL) between myopic children wearing ortho-K lenses and single-vision spectacles (SVSs), living in Kuala Lumpur, using Paediatric Refractive Error Profile (PREP) questionnaires.

**Methods:** This is a cross sectional study. Myopic children who had been wearing ortho-K and SVSs for 12 months were recruited, and the questionnaires were distributed online. The PREP scores were obtained using a summary scoring method. The Shapiro–Wilk test was used to determine data normality. Unpaired *t*-test was performed for normally distributed data, and the Mann–Whitney test for non-normally distributed data.  $P < 0.05$  was considered significant.

**Results:** A total of 70 subjects participated in this study (45 ortho-K and 25 SVSs), with a mean age of  $10.86 \pm 0.73$  years. The mean scores for all the items were higher in ortho-K than SVS wearers ( $p < 0.05$ ). With regard to symptoms during ortho-K lens wear at night,  $<10\%$  of the subjects reported difficulty falling asleep, itch/burning/dry eyes and foreign body sensation after lens insertion.

**Conclusion:** Ortho-K improves the vision-related quality of life of myopic school children in Kuala Lumpur. Thus, it should be considered by more local optometrists when managing myopic children.

### 1. Introduction

Myopia has emerged as a global public health issue due to its dramatic increase in prevalence in recent decades, specifically in East Asia (including Malaysia), affecting 60–90 % of teenagers [1,2]. In parallel, there has also been an increase in the average degree of myopia in Chinese populations, recording some of the largest increases [3]. Myopia occurring at a young age is more likely to progress to high myopia, which is associated with several sight-threatening diseases, such as glaucoma and retinal detachment [4,5].

Orthokeratology (ortho-K) has been shown to be an effective alternative method of correcting myopia and slowing myopia progression in

children and is one of the most commonly used techniques to control myopia progression in China, Taiwan and Japan [6–8]. The method has been progressively accepted by many myopic children and their parents, probably because the lenses are only worn while sleeping, and the children enjoy spectacle/contact lens-free daytime to participate in physical and social activities.

Myopic children younger than 12 years old reported better vision-related quality of life when wearing contact lenses as compared to spectacles [9,10]. The Paediatric Refractive Error Profile (PREP) questionnaire has been specifically designed to evaluate children's vision-related quality of life (VRQoL) who are affected by refractive error. Even though PREP was not specifically designed for contact lens or

\* Corresponding author at: Optometry and Vision Science Program, Research Centre for Community Health (REACH), Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Jalan Raja Muda Abdul Aziz, 50300 Kuala Lumpur, Malaysia.

E-mail address: [bariah@ukm.edu.my](mailto:bariah@ukm.edu.my) (B. Mohd-Ali).

<https://doi.org/10.1016/j.clae.2022.101774>

Received 5 July 2022; Received in revised form 8 October 2022; Accepted 18 October 2022

1367-0484/© 2022 The Authors. Published by Elsevier Ltd on behalf of British Contact Lens Association. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

ortho-K lens wearers, it has been used by few investigators to detect differences between children wearing different visual aids [11]. Santodomingo-Rubido et al. [12] compared the VRQoL between children wearing ortho-K lenses and single-vision spectacles using PREP questionnaires and found that the scores of most items (except near vision and lens handling in ortho-K-wearing children) were significantly better than those of children wearing single-vision spectacles (SVSs). In another study, Yang et al. [13] conducted a similar investigation among myopic children in China, aged between 8 and 12 years. Their results demonstrated better VRQoL scores in ortho-K-wearing children than in those who wore SVSs. The authors concluded that, although ortho-K lenses induce some ocular discomfort during lens wear at night, the benefits of wearing ortho-K offset the discomfort, leading to a better vision-related quality of life than those wearing SVSs.

Despite the positive reports, there are some concerns about the capabilities of young children to handle and care for contact lenses in Malaysia. Moreover, children who wear ortho-K lenses sometimes complain of itchiness and dryness during lens wear at night, which lead to concerns among parents about their children's quality of vision during the daytime. To date, there are limited reports available in the literature about VRQoL among ortho-K-wearing children in East Asian countries. Therefore, the purpose of this study was to evaluate and compare the VRQoL between myopic school children wearing overnight ortho-K lenses and SVSs for 12 months in Malaysia. This study focused on Chinese myopic school children living in Kuala Lumpur due to their higher prevalence of myopia than other races in Malaysia [14,15].

## 2. Materials and Methods

This study is part of the Myopia Control Study in Kuala Lumpur (MyCOSKL), designed to evaluate the efficacy and acceptance of ortho-K lenses versus SVSs in myopic school children for 12 months. The research protocol was approved by the research ethics committee of the Universiti Kebangsaan Malaysia (UKM PPI/111/8/JEP-2022-281) and was conducted in accordance with the tenets of the Declaration of Helsinki. Written consent was obtained from the parents or guardians of all participants prior to data collection. The sample size required in this study was calculated using statistical package software G-Power version 3.1.9.7, based on the mean and standard deviation (SD) of overall vision scores for ortho-K lens wearers and spectacles wearers from previous study [13]. To achieve a power of 90% with a significance level of 0.05, a sample size of at least 24 was needed.

The inclusion criteria were a spherical equivalent refractive error (SER) of  $-0.75 < \text{SER} < -4\text{D}$ , astigmatism less than  $\leq 1.50\text{D}$  in both eyes, best corrected visual acuity (BCVA) 0.0 log of minimal angle of resolution (logMAR) in each eye, birth weight of  $\geq 2000\text{g}$ , no history of ocular or systemic disease, wearing contact lenses or myopia treatment. All subjects were wearing single vision spectacles prior to starting of the study. Subjects were allocated to either the OK group or SVS group based on the decisions of the children and their parents or guardians. The advantages and disadvantages of the two vision correction modalities offered in this study were explained to them at the beginning of the study. Care was taken not to suggest that one modality might perform better than the other or provide better control over myopia progression.

Subjects in the SVS group were prescribed distance SVSs with a spherical design made from plastic material with a refractive index of 1.56 (Integrated Lens Technology (ILT), Singapore) and were asked to wear the spectacles for full time. Subjects in the contact lens group were fitted with the ortho-K lenses (Menicon Z night, Menicon, Japan) to be worn overnight. The initial lens parameters were determined using the computer software provided by the manufacturer (Easyfit Software, Menicon Co., Ltd, Nagoya, Japan). Corneal topography and cycloplegic refraction data for both eyes were input into the software, which automatically calculated the specifications of the Menicon Z night trial lenses to allow orthokeratology lens fitting. OK lenses were ordered and dispensed to subjects approximately 3 weeks after baseline examination.

All participants returned for follow-up examination at 1 week, and 1, 3, 6, 9 and 12 months. During follow-up visits, participants received new contact lenses or SVSs if overcorrection improved visual acuity by 3 letters or more, if the change in SER was  $-0.50\text{D}$  or greater, or at the optometrist's discretion if the child experienced any visual symptoms throughout the study.

This study used the original Paediatric Refractive Error Profile (PREP) questionnaire for the SVS participants and modified PREP for the ortho-K wearers (PREP-OK). The PREP-OK is a minimally modified version of the PREP questionnaire proposed by Yang et al. [13], who substituted the word/clause 'glasses'/'When I wear my glasses' with 'ortho-K'/'After 1 wore ortho-K lenses' to address the same issues. The same 26 questions on overall vision, near vision, far vision, symptoms in the daytime, appearance, satisfaction, activities, academic performance, handling of optical corrections and peer perceptions were used for both questionnaires. As described by Walline et al. [9], the children were asked to read the 26 statements in the questionnaire and mark one of the following: 'strongly agree', 'agree', 'neutral', 'disagree' and 'strongly disagree' according to their experience and feelings. The scoring of the questionnaire was calculated following the instructions provided for the PREP questionnaire [9]. Each statement was scored from 5 (positive) to 1 (negative) and then scaled to 100 (excellent quality of life) to 0 (poor quality of life) by subtracting 1 from the raw score of each question and multiplying it by 25, and the overall PREP score was the average of all 26 statements.

Following Yang et al. [13], the ortho-K subjects were asked to read 4 extra questions (PREP-OK) (Table 1) about the symptoms during ortho-K lens wear at night using the same scale of 1–5 and the scores recorded and reported independently, without scaling to 100. The reliability of PREP-OK questionnaires was analysed by Yang et al [13] using Cronbach's Alpha reliability analysis and the value was 0.75. The Cronbach's Alpha for the split halves for PREP OK was 0.71 and 0.71 respectively. However, the questionnaires were not validated for specificity and sensitivity.

Due to restrictions during the COVID-19 pandemic, the optometrists were unable to administer the questionnaires directly to the participants. Instead, the questionnaires (PREP and PREP-OK) were emailed to all the parents to administer them at home. Children were asked to read all 26 statements for SVS wearers and 30 statements for ortho-K wearers without skipping any of them. An online briefing session was given to the parents and children prior to data collection, and the parents were asked to guide their children if they faced any difficulties answering the questions. The questionnaires were submitted online immediately upon completion, and the results were analysed accordingly.

Data were analysed using Statistical Packages for Social Sciences (SPSS) software version 23.0. The Shapiro–Wilk test was used to determine the normality of the data. The mean and standard deviation (SD) are reported for normally distributed data, while the median and range are reported for non-normally distributed data. Analysis using an

**Table 1**

Additional questions for symptoms during orthokeratology lens wear at night [13].

	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
1.					
2.					
3.					
4.					

\*Each statement was scored from 5 (positive) to 1 (negative).

<sup>a</sup> Statements that are reverse coded so that 'strongly disagree' corresponds.

unpaired *t*-test was performed for normally distributed data, and the Mann–Whitney test was used for non-normally distributed data. For all analyses,  $P < 0.05$  was considered significant.

### 3. Results

A total of 70 Chinese children (40 males and 30 females) living in Kuala Lumpur were included in this study. The mean age of the participants were  $10.86 \pm 0.73$  years. Forty-five (45) of them were wearing ortho-K lenses, and another 25 were wearing SVSs. All the subjects (100 %) had completed a 12-month follow-up examination before answering the questionnaires. A summary of the characteristics and baseline data of the subjects is shown in Table 2.

A comparison of the PREP scores between ortho-K and SVS wearers is summarized in Table 3. The analysis showed that the scores for all items (overall vision, near vision, far vision, symptoms, appearance, satisfaction, activities, academics and handling scores), except peer perception, were significantly higher ( $p < 0.05$ ) in ortho-K than SVS wearers. No significant difference was noted in the score for peer perception between groups ( $p = 0.10$ ). Table 4 presents the summary of the results of symptoms experienced by ortho-K wearers at night (PREP-OK). The results showed that the majority of the ortho-K wearers did not experience symptoms during lens wear at night; 14 subjects reported that they disagreed, and 30 reported that they strongly disagreed. Only one subject experienced ocular discomfort; one subject agreed that he/she experienced difficulty falling asleep at night while wearing ortho-K lens; two subjects agreed that their eyes itched, burned, or felt dry while wearing ortho-K lenses; and three subjects felt a foreign body sensation during ortho-K lens wear at night.

### 4. Discussion

This study investigated and compared VRQoL between Chinese myopic school children wearing ortho-K lenses and SVSs for 12 months in Kuala Lumpur. All the subjects completed the 12 months follow up visits at the university Optometry clinic. The overall score was significantly higher in the ortho-K than SVS wearers. Even though there was no significant difference in distance and near VA at baseline and at 12 months between both groups, the results showed a higher score of overall, far and near vision of ortho-K lens than SVS wearers. This could be because ortho-K lenses provide not only good central vision, but also better peripheral vision than spectacle lenses [9,16]. Yang et al. demonstrated similar findings in overall vision and distance vision but not in near vision [13]. Their results showed no significant difference in the scores of near vision between ortho-K and SVS wearers, which is similar to the results of Walline's study, where the VRQoL of soft contact lens wearers was compared to that of SVSs [9]. Nevertheless, Santodomingo-Rubido et al. reported a lower near vision score in ortho-K than SVS wearers, which they attributed to a slight overcorrection and diurnal regression in their ortho-K subjects [7].

**Table 2**  
Characteristics of subjects.

Parameters	Orthokeratology(N = 45)	Single-Vision Spectacles (N = 25)	P value
Age during recruitment (years)	$8.38 \pm 0.49$	$8.38 \pm 0.49$	0.110
Male/Female	21/24	15/10	0.289
Refraction in sphere equivalent (D)	$-3.22 \pm 1.11$	$-3.03 \pm 1.35$	0.529
Best corrected visual acuity (BCVA)	$-0.01 \pm 0.08$	$0.00 \pm 0.05$	0.378
Keratometer reading (D)	$43.6 \pm 1.27$	$43.12 \pm 1.03$	0.116
Axial length (mm)	$23.85 \pm 0.71$	$23.45 \pm 0.97$	0.082
Body height (cm)	$126.07 \pm 7.96$	$123.76 \pm 6.61$	0.221
Body weight (kg)	$27.26 \pm 6.35$	$25.6 \pm 4.34$	0.201

**Table 3**

Mean and standard deviation Paediatric Refractive Error Profile (PREP) scores in orthokeratology and single-vision spectacle wearers at 12 months.

Items	Orthokeratology (N = 45)	Single-vision spectacle (N = 25)	P value
Overall vision	$92.78 \pm 12.88$	$78.33 \pm 20.41$	0.02
Near vision	$86.39 \pm 20.78$	$75 \pm 18.39$	0.03
Far vision	$89.17 \pm 14.75$	$74 \pm 23.91$	0.00
Symptoms	$91.94 \pm 11.18$	$78.5 \pm 14.10$	0.00
Appearance	$89.07 \pm 11.76$	$58.33 \pm 14.02$	0.00
Satisfaction	$91.67 \pm 11.92$	$75 \pm 17.68$	0.00
Activities	$89.44 \pm 13.31$	$51.55 \pm 22.33$	0.00
Academics	$92.22 \pm 11.39$	$78 \pm 9.04$	0.00
Handling	$77.92 \pm 13.69$	$68.75 \pm 14.09$	0.01
Peer perception	$78.89 \pm 17.64$	$71.67 \pm 17.34$	0.10
Overall	$87.95 \pm 12.88$	$71.41 \pm 11.18$	0.00

**Table 4**

Summary of the results of symptoms experienced by orthokeratology wearers at night.

Symptoms	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Hard to fall asleep	0	1	0	14	30
Eye discomfort	0	0	1	13	31
Eyes itch/burn/feel dry	1	1	0	12	31
Strong foreign body sensation	0	0	3	12	30

Regarding appearance, satisfaction and activities, the results of this study demonstrated higher scores in ortho-K than SVS wearers, which is in agreement with previous works [7,13]. These findings could be explained by the modality of ortho-K lenses that only need to be worn at night and enjoy clear vision during the daytime, without the need for spectacles or contact lenses. This is convenient when the children participate in sports and other social activities. Zhao et al. compared the quality of life (QoL) scores before and after ortho-K lens wear in Chinese children, and their results showed higher QoL scores after commencing ortho-K lens wear [17]. The main reason why the children chose to wear ortho-K lenses in their study was convenience in sports.

Interestingly, the results of this study showed no significant difference ( $p = 0.10$ ) in the score for peer perception between both groups, which may be related to the participants' age. Walline et al. investigated children's perception of other children with spectacles, and their results demonstrated that children between the ages of 6 and 10 years typically do not make judgements on their peers based on spectacle wear, but they believe that children who wear spectacles appear smarter [18].

With regard to the handling of optical corrections, the results of this study showed a significantly higher score in ortho-K lens wearers than SVSs. These findings differ from Yang's study, which demonstrated lower scores in ortho-K lens wearers than SVSs. According to Yang et al., the handling of ortho-K lenses and its accessories requires more time and effort compared to SVSs [13]. Spectacles are easier to handle, resulting in higher scores in handling compared to ortho-K wearers. Pomedá et al. reported higher scores in handling in the soft contact lens group than in the SVS group, indicating that children are able to successfully handle contact lenses [19]. In MyCOSKL, ortho-K lens wearers were reminded repeatedly through phone calls and follow-up visits to strictly follow lens care procedures and maintain good compliance. The children were also asked by the optometrists to demonstrate their lens handling techniques during follow-up visits to ensure correct procedures were followed. This is probably why the score in handling was higher in ortho-K than that of SVS wearers in this study.

Significant differences were noted between scores for symptoms in the daytime between ortho-K lens and SVS wearers in this study. This is

probably because all the ortho-K lens wearers in this study had been wearing the lenses for 12 months and had adapted well. Santolaria et al. investigated the subjective satisfaction in long-term ortho-K lens adult wearers and reported that light distortion, such as haloes, which occurred in the early stage of the treatment, was the most common symptom experienced by the adult wearers [20]. Nevertheless, for most subjects, the situation improved after several weeks of treatment. The authors postulated that the time required for adaptation to lens wear may be related to age, and it takes longer for older subjects to adapt.

With regard to academic performance, the results of this study are similar to those of an earlier report by Santodomingo-Rubido et al. [7]. Even though both ortho-K and SVSs provided satisfactory visual acuity in both groups, the scores for academic performance were higher in ortho-K lens than SVS wearers. According to Santodomingo-Rubido et al., the lower scores in the academic performance of the SVS group were attributed to the failure of the children to actually wear their spectacles during school and homework time [7]. This study tends to agree with the assumption because a few parents in this study complained of their children's poor compliance in wearing spectacles during homework time.

Regarding the four additional questions (PREP-OK) about the symptoms experienced by ortho-K lens wearers, the majority of the subjects disagreed that ortho-K lens wear affected their ability to fall asleep at night. Very few subjects experienced ocular discomfort, itchy/burning/dry eyes and foreign body sensations during ortho-K wear at night. Since ortho-K lenses are rigid, they may induce ocular discomfort during initial fitting. However, the symptoms improved after several weeks of adaptation. The ortho-K wearers in this study demonstrated good compliance with follow-up visits and contact lens maintenance within 12 months of wearing contact lenses, which was probably why very few subjects experienced symptoms of itchiness/burning/dry eyes during ortho-K lens wear at night. According to Yang et al., even though ortho-K may induce some ocular discomfort at night, the benefits of ortho-K may compensate for the discomfort, leading to better scores in VRQoL compared to SVSs [13]. Nevertheless, the investigators in this study are aware that the additional questions have not been validated for specificity and sensitivity prior to data collection, which may introduce some bias in the findings.

There are several limitations in this study. The first limitation is that the questionnaires were not administered directly by the optometrists. Instead, they were distributed online with parental guidance at home. Even though an online explanation was given to parents and children prior to data collection, this study were unable to determine any specific problems faced by the children while answering the questionnaires, which may introduce some bias in the study. Future VRQoL questionnaires should be administered by optometrists in the clinic. The second limitation is the method of data analysis. Following previous reports [12,13], this study used the summary scoring method for data analysis. The method is known to have few conceptual drawbacks including lack of an explicit ordered continuum of items that represent a unidimensional construct and lack of additivity of rating scale data [21,22]. The investigators are aware that Rasch analysis is a more suitable method to use for data analysis as it allows investigators to use respondent's raw scores and express the respondent's performance on a linear scale that accounts for the unequal difficulties across all the test items. However, expert in Rasch analysis was not available during the time of study and therefore the data was analysed using the summary scoring method. Lastly, this study was not able to compare the impact of ortho-K lenses on the children's quality of life before and after ortho-K lens wear because the questionnaires were only administered after 12 months of wearing ortho-K lenses. Quality of life should be evaluated before and after the commencement of ortho-K lens wear in future studies.

## 5. Conclusions

This study demonstrated that myopic Chinese schoolchildren

wearing ortho-K reported higher VRQoL score than those wearing SVS. Orthokeratology should be considered by more optometrists when managing myopic children.

## Funding

This study was funded by Menicon Ltd, Japan (NN-2022-019).

## 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.

## Acknowledgement

The authors acknowledged all the children and their parents for their participation and Ms Sharon Muthiah for her assistance in data collection.

## References

- [1] Pan CW, Dirani M, Cheng CY, Wong TY, Saw SM. The age-specific prevalence of myopia in Asia: A meta-analysis. *Optom Vis Sci* 2015;92(3):258–66.
- [2] Liang YB, Wong TY, Sun LP, Tao QS, Wang JJ, Yang XH, et al. Refractive errors in a rural Chinese adult population the Handan eye study. *Ophthalmology* 2009;116(11):2119–27.
- [3] Morgan IG, Ohno-Matsui K, Saw SM. Myopia. *Lancet* 2012;379(9827):1739–48.
- [4] Holden BA, Fricke TR, Wilson DA, Jong M, Naidoo KS, Sankaridurg P, et al. Global Prevalence Of Myopia and High Myopia and Temporal Trends from 2000 through 2050. *Ophthalmology* 2016;123(5):1036–42.
- [5] Wong YL, Saw SM. Epidemiology of pathologic myopia in Asia and worldwide. *Asia Pac J Ophthalmol (Phila)* 2016;5(6):394–402.
- [6] Cho P, Cheung SW, Edwards M. The longitudinal orthokeratology research in children (LORIC) in Hong Kong: a pilot study on refractive changes and myopic control. *Curr Eye Res* 2005;30:71–80.
- [7] Santodomingo-Rubido J, Villa-Collar C, Gilmartin B, Gutierrez-Ortega R. Myopia control with orthokeratology contact lenses in Spain: refractive and biometric changes. *Invest Ophthalmol Vis Sci* 2012;53:5060–505.
- [8] Hiraoka T, Kakita T, Okamoto F, Takahashi H, Oshika T. Long term effect of overnight orthokeratology on axial length elongation in childhood myopia: a 5-year follow up study. *Invest Ophthalmol Vis Sci* 2012;53:3913–4399.
- [9] Walline JJ, Gaume AJ, Jones-Jordan LA, Rah MJ, Manny RE, Bernsten DA, et al. Benefits of contact lens wear for children and teens. *Eye Contact Lens* 2007;33:317–21.
- [10] Rah MJ, Walline JJ, Jones-Jordan LA, Sinnott LT, Jackson JM, Manny RE, et al. Vision specific quality of life of paediatric contact lens wearers. *Optom Vis Sci* 2010;87:560–656.
- [11] Walline JJ, Bailey MD, Zadnik K. Vision specific quality of life and modes of refractive error correction. *Optom Vis Sci* 2000;77:648–52.
- [12] Santodomingo-Rubido J, Villa-Collar C, Gilmartin B, Gutierrez-Ortega R. Myopia control with orthokeratology contact lenses in Spain: a comparison of vision-related quality of life measures between orthokeratology lenses and single vision spectacles. *Eye Contact Lens* 2013;39:153–7.
- [13] Yang B, Ma X, Liu L, Cho P. Vision-related quality of life of Chinese children undergoing Orthokeratology treatment compared to single vision spectacles. *Contact Lens Ant Eye* 2021;44:1–6.
- [14] Chung KM, Yeow PT, Mohidin N, O'Leary DJ. The association between myopia and gender in Chinese school children. *Sains Malaysiana* 1995;24(3):67–71.
- [15] Saw SM, Goh PP, Cheng A, Shankar A, Tan DT, Ellwein LB. Ethnicity-specific prevalence of refractive errors vary in Asian children in neighbouring Malaysia and Singapore. *Br J Ophthalmol* 2006;90(10):1230–5.
- [16] Lin Z, Martinez A, Chen X, Li I, Sankaridurg P, Holden BA, et al. Peripheral defocus with single-vision spectacle lenses in myopic children. *Optom Vis Sci* 2010;87:4–9.
- [17] Zhao F, Zhao G, Zhao Z. Investigation of the effect of orthokeratology lenses on quality of life and behaviors of children. *Eye Contact Lens* 2018;44:335–8.
- [18] Walline JJ, Sinnott L, Johnson ED, Ticak A, Jones SL, Jones LA. What do kids think about kids in eye glasses. *Ophthalmic Physiol Opt* 2008;28(3):218–24.
- [19] Pomedá AR, Perez-Sanchez B, Canadas Suarez MDP, Prieto Garrido FL, Gutierrez-Ortega R, Villa-Collar C. MiSight Assessment Study Spain; a comparison of vision related quality of life measures between MiSight contact lenses and single vision spectacles. *Eye Contact Lens* 2018;44:S99–104.

- [20] Santolaria E, Cervino A, Queiros A, Brautaset R, Gonzalez-Mejome JM. Subjective refraction in long term orthokeratology patients. *Eye Contact Lens* 2013;39:388–93.
- [21] Kandel H. Quality-of-life outcomes of long-term contact lens wear: A systematic review. *Cont Lens Anterior Eye* 2022;45(1):101521. <https://doi.org/10.1016/j.clae.2021.101521>.
- [22] Kandel H, Khadka J, Goggin M, Pesudovs K. Patient-reported Outcomes for Assessment of Quality of Life in Refractive Error: A Systematic Review. *Optom Vis Sci* 2017;94(12):1102–19.