

# Prevalence and Determinants Associated With Spectacle-Wear Compliance in Aphakic Infants

Qianzhong Cao<sup>1,\*</sup>, Xiaoyan Li<sup>1,\*</sup>, Duoru Lin<sup>1</sup>, Zhenzhen Liu<sup>1</sup>, Jing Li<sup>1</sup>, Haofeng Jiang<sup>1</sup>, Zhuoling Lin<sup>1</sup>, Jingjing Chen<sup>1</sup>, Xiaohang Wu<sup>1</sup>, Erping Long<sup>1</sup>, Yingfen Lin<sup>1</sup>, Jinzhu Tang<sup>1</sup>, Xing Chen<sup>1</sup>, Sijian Huang<sup>1</sup>, Haotian Lin<sup>1</sup>, Weirong Chen<sup>1</sup>, and Yizhi Liu<sup>1</sup>

<sup>1</sup> State Key Laboratory of Ophthalmology, Zhongshan Ophthalmic Center, Sun Yat-sen University, Guangzhou, Guangdong, 510060, People's Republic of China

**Correspondence:** Haotian Lin, Zhongshan Ophthalmic Center, Xian Lie South Road 54#, Guangzhou, China, 510060. e-mail: haot.lin@hotmail.com

**Received:** 21 March 2018

**Accepted:** 25 September 2018

**Published:** 14 November 2018

**Keywords:** spectacle-wearing compliance; aphakic infants; congenital cataract; associated factors

**Citation:** Cao Q, Li X, Lin D, Liu Z, Li J, Jiang H, Lin Z, Chen J, Wu X, Long E, Lin Y, Tang J, Chen X, Huang S, Lin H, Chen W, Liu Y. Prevalence and determinants associated with spectacle-wear compliance in aphakic infants. *Trans Vis Sci Tech.* 2018;7(6):5, <https://doi.org/10.1167/tvst.7.6.5> Copyright 2018 The Authors

**Purpose:** We assess the prevalence of spectacle wear and the factors associated with compliance among aphakic infants with congenital cataracts who underwent lens extraction in South China.

**Methods:** Infants aged 3 months to 3 years were enrolled from among participants in the Childhood Cataract Program of the Chinese Ministry of Health (CCPMOH). The prevalence and potential determinants of spectacle-wearing compliance were identified from interviews with the infants' caregivers.

**Results:** Among 192 infant caregivers, the mean (SD) age of the infants was 1.89 (0.50) years, and 57% were males. Compliance was 30.9% in the 3-month- to 1-year-old age group, 78.0% in the 1- to 2-year-old age group, and 87.0% in the 2- to 3-year-old age group. The following two factors were associated with spectacle-wearing compliance: softness of the spectacles frame ( $\beta = 1.273$ ,  $P = 0.002$ , odds ratio [OR] = 3.6, 95% confidence interval [CI] = 1.6–8.0) and communication with other caregivers regarding the spectacle-wearing experience ( $\beta = -2.955$ ,  $P = 0.034$ , OR = 0.1, 95% CI = 0–0.8).

**Conclusions:** Compliance with spectacle wear was low during the earlier stage, but increased with time in aphakic infants. However, overall compliance should be improved. Therefore, efficient strategies aimed at improving spectacle-wearing compliance are needed.

**Translational Relevance:** These findings reveal the low spectacle-wearing compliance in aphakic infants and support useful information to improve compliance.

## Introduction

In recent decades, congenital cataract has become a primary cause of treatable childhood blindness.<sup>1,2</sup> The global prevalence of this disease is estimated to be 1 to 15 per 10,000 children, and its prevalence is approximately 10-fold higher in developing than in developed countries.<sup>3</sup> In China, the incidence of congenital cataract is approximately 5.0 per 10,000 births,<sup>4,5</sup> and 20% to 30% of childhood blindness has been attributed to the absence of appropriate treatment for congenital cataract.<sup>6</sup> To prevent congenital cataract from developing into irreversible deprivation amblyopia, early diagnosis and timely

surgery within the critical period of visual development are extremely important.<sup>7,8</sup> In aphakic infants, it is necessary to appropriately correct refractive errors following lens extraction surgery to obtain clear vision. Although contact lenses have been recommended as the first choice to correct aphakia in infants, spectacles are selected by most caregivers in China.

Currently, refractive errors account for half or more of all cases of impaired vision in most surveyed populations,<sup>9–15</sup> and using appropriate spectacles to correct refractive errors is among the most cost-effective vision-improving interventions available in eye care.<sup>16</sup> Many studies have investigated spectacle-

wearing compliance and associated factors in phakic eyes,<sup>17–20</sup> but spectacle compliance in aphakic children remains unexplored.

To assess the prevalence of spectacle wear and the factors associated with compliance among infants with congenital cataract who underwent lens extraction surgery, we conducted this cross-sectional study at Zhongshan Ophthalmic Center, one of the best and largest eye hospitals in China.<sup>21</sup>

## Materials and Methods

This study was conducted according to the ethical principles described in the Declaration of Helsinki. All appropriate study documents were reviewed and approved by the Zhongshan Ophthalmic Center Independent Ethics Committee. Before questionnaires were administered, all caregivers were informed of all information about this survey, and consent always was obtained before interviews were performed.

### Subjects

The infants enrolled in the study were aged 3 months to 3 years and had been registered in the Childhood Cataract Program of the Chinese Ministry of Health (CCPMOH) at Zhongshan Ophthalmic Center, Sun Yat-sen University. The following inclusion criteria were applied: suffered from bilateral congenital cataract, had lens extraction surgery without intraocular lens (IOL) implantation at 3 to 6 months of age, used spectacles for refractive errors correction, and had no other physical or mental disorders. The sample size for the survey was calculated according to the following formula:  $N = [(Z_{\alpha/2})^2 \times P \times (1 - P)] / (\text{MOE}^2)$ , where  $\alpha$  represents a Type I error of 0.05,  $P = 0.65$  was the estimated rate of spectacle wear,  $\text{MOE} = 0.08$  was the margin of error (maximum tolerated error), and  $N$  was 137, which represented the number of valid respondents required for the survey. After adjusting for an expected response rate of 80%, the expected number of persons for whom interviews were required was  $137/0.80 = 172$ .

### Methods

This cross-sectional study, attached to the Childhood Cataract Program of the Chinese Ministry of Health (CCPMOH), aimed to explore the influence of early interventions on long-term outcomes in pediatric cataract patients. All infants enrolled in this study underwent a retinoscopy test and received spectacles

since 1 week after cataract extraction surgery. The lens was changed if the power decreased over 1 diopter in every 3-month routine screening. One pair of spectacles that corrected for near was given to those younger than 1 year, while two pairs of spectacles (one corrected for near and the other for distance) were given to those >1 year old, and the near addition was 3 diopters. The frames were manufactured by SYSU VISION, a Chinese eyewear manufacturer and TOMATO Glasses, a Korean glasses manufacturer. The frames were designed for East Asian baby wearing, and were made of cellulose acetate propionate, TR90, and silicon. Spectacle-wearing compliance, mean power of the spectacles lenses, spectacle characteristics, and caregiver knowledge about pediatric cataract treatment of the caregivers were recorded and evaluated during daily screenings. Good spectacle-wearing compliance was defined as wearing spectacles full-time without pulling the spectacles away when awake either for extended periods or occasionally.

The infant caregivers were interviewed based on the designed questionnaire shown in [Supplementary File S1](#). All questions were modified to ensure that they were understandable and resulted in reliable answers in a pilot study. All interviews were performed by one experienced interviewer.

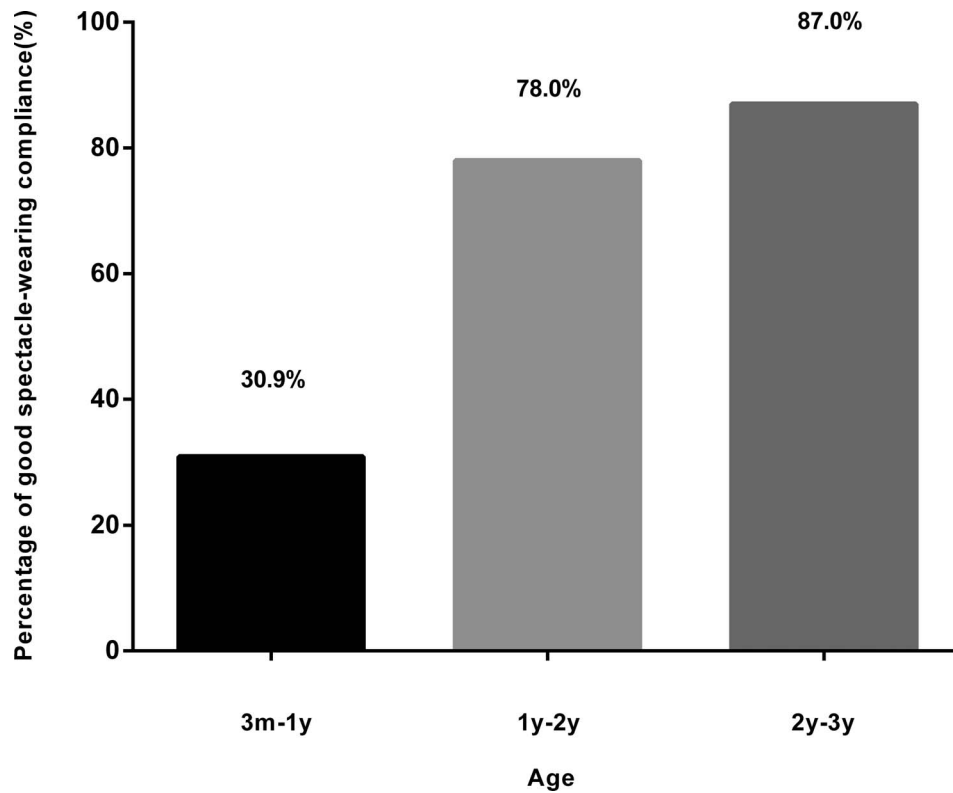
### Data Collection and Statistical Analysis

Data were recorded, reviewed for accuracy, and analyzed by two researchers. The  $\chi^2$  test was used to analyze factors that potentially affected spectacle-wearing compliance, and  $P < 0.05$  was considered significant. Binary logistic regression was conducted to further analyze the factors that affected spectacle-wearing compliance.

## Results

From January 2017 to October 2017, 225 cases met the inclusion criterion. Among these, 192 infants' caregivers (85.3%, 192/225) agreed to participate and successfully completed the interview.

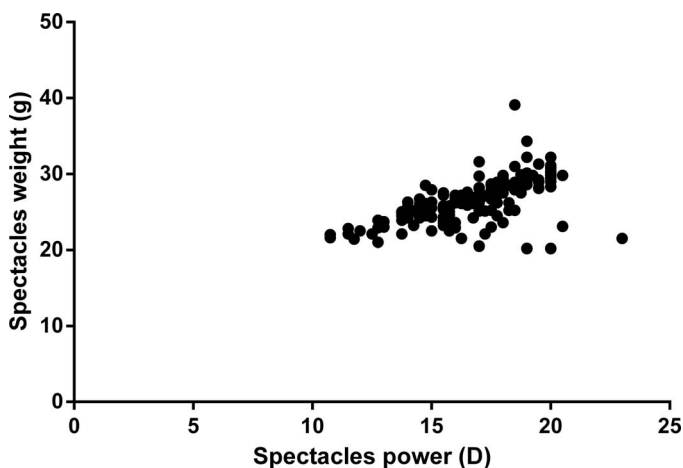
In total, data were collected for 101 males and 91 females for analysis. Age ranged from 3 months to 1 year (group 1), 1 to 2 years (group 2), and 2 to 3 years (group 3) in 55, 68, and 69 infants, respectively. The percentage of infant caregivers reporting good compliance is shown in [Figure 1](#). The distribution of lens diopters and total spectacles weight is shown in [Figure 2](#).



**Figure 1.** Percent compliance with spectacle-wear in the three age groups. The percentage of infant caregivers who reported good compliance was 30.9% in group 1 (3 months~1 year), 78.0% in group 2 (1~2 years) and 87.0% in group 3 (2~3 years).

Single- and multi-factor analyses were conducted to investigate the relationship between spectacle-wearing compliance and the factors potentially affect it. Nine independent variables, including five objective and four subjective factors were analyzed with the  $\chi^2$  test (Table 1). Two objective factors (factor 1,

softness of spectacles frame and factor 3, spectacles tightness) and two subjective factors (factor 8, knowledge of amblyopia therapy and factor 9, communication regarding spectacle wear) were significant, and these factors were selected for inclusion in the binary logistic regression analysis, in which the dependent variable was whether there was good compliance. Two factors (softness of the spectacles frame and communication with other caregivers about the spectacle-wearing experience) were significant in the regression analysis (Table 2).



**Figure 2.** A scatter plot of spectacles weight and the mean diopter of the two lenses. Spectacles weight is positively correlated with spectacles diopter.

## Discussion

We found that there was low compliance with spectacle-wearing in the earlier stage among aphakic infants who underwent cataract surgery. While previous studies have shown that compliance is relatively high in spectacle-wearing children younger than 8 years,<sup>22</sup> all subjects involved in these studies were phakic. To the best of our knowledge, our data fill a gap in what currently is known about aphakic infants and indicated that there is low compliance in the earlier stage of spectacle wear (30.9%).

**Table 1.** The Results of the  $\chi^2$  Tests for the Nine Potential Factors Influencing Spectacle-Wearing Compliance

Factors	P	OR	95% CI for OR	
			Lower	Upper
Objective factors				
1. Softness of spectacles frame	0.001*	3.7	1.6	7.3
2. Spectacles frame warp	0.708	1.0	0.1	11.5
3. Spectacles tightness	0.043*	0.1	0.0	0.9
4. Degree of lens scratches	0.398	0.5	0.1	3.1
5. Lens dirt resistance	0.249	0.3	0.1	2.9
Subjective factors				
6. Knowledge of common operative complications	0.184	0.2	0.1	2.2
7. Knowledge of treatment plan	0.077	0.2	0.0	1.1
8. Knowledge of amblyopia therapy	0.010*	3.0	1.2	7.6
9. Communication regarding spectacle wear	0.007*	0.1	0.0	0.5

\* Significant at  $P < 0.05$ .

Since the infant's functional world is very close, the basic refractive correction for children usually was for near. Good compliance using contact lenses to correct aphakia for near in infants was found in an Infant Aphakia Treatment Study.<sup>23,24</sup> For aphakic infants enrolled in this CCPMOH, a pair of spectacles that corrected for near also was used, and +3.0 diopters were added to the refractive error, which can provide a near-point correction at 30 cm. While for toddlers aged over 1 year, another pair of spectacles that corrected for distance vision was used when they were walking.

Our results demonstrated that spectacle-wearing compliance was better in the older than in the younger group, possibly because older children tend to require lower diopter lenses<sup>25</sup> and, therefore, have lighter spectacles. In addition, older infants may be more eager than younger infants to have clear vision when exploring, because younger infants spend more time sleeping. Additionally, older infants may be better accustomed than younger infants to wearing spectacles, because they have had a longer adaption period.

The following two factors contributed substantially to spectacle-wearing compliance. The first was the softness of the frames, possibly because higher softness made the spectacles fit better and more comfortable to wear. This finding is supported by the study of Horwood,<sup>22</sup> who found that a good fit was one of the most influential factors that promoted good compliance. The other contributing factor was communication with other caregivers about the spectacle-wearing experience, perhaps because it enhanced the caregivers' understanding about the importance of wearing spectacles and increased their attentiveness to spectacle-wearing behaviors.

Two interventions, including choosing soft frames and improving caregivers' knowledge about spectacles wearing, deserve implementation to improve spectacle-wearing compliance. The latter intervention indicates that lectures involving caregivers sharing their experience with spectacle wearing may improve spectacle-wearing compliance among aphakic infants. Moreover, social media platforms, such as WeChat or

**Table 2.** Factors Influencing Spectacle-Wearing Compliance Analyzed by the Binary Logistic Regression Analysis

Factors	$\beta$	P	OR	95% CI for OR	
				Lower	Upper
Softness of spectacles frame	1.273	0.002*	3.6	1.6	8.0
Communication regarding spectacle-wear	-2.955	0.034*	0.1	0.0	0.8

The binary logistic regression analysis (Forward Conditional) was performed based on two objective factors (factors 1 and 3) and two subjective factors (factors 8 and 9) that selected from the results of  $\chi^2$  tests, and two factors were significant in the regression analysis.

\* Significant at  $P < 0.05$ .

QQ in China, may provide a platform for caregivers to communicate about the spectacle-wearing experience. In addition, ophthalmologists and optometrists should be encouraged to pay more attention to spectacle-wearing compliance in infants who undergo congenital cataract surgery and provide caregivers with information regarding how they might improve spectacle-wearing compliance in their aphakic infants.

In summary, compliance was low in the early stage of spectacle-wear. Although compliance increases with time, it remains unsatisfactory. Furthermore, efforts aimed at improving the softness of frames and educating caregivers about the treatment plan may lead to improved spectacle-wearing compliance and better treatment outcomes.

## Acknowledgments

Supported by the National Key Research and Development Program (2018YFC0116500), the National Natural Science Foundation (NSFC81770967, 91546101, and 81300750), the Guangdong Provincial Natural Science Foundation for Distinguished Young Scholars of China (2014A030306030), the Youth Pearl River Scholar Funded Scheme (2016-2018), the Clinical Research and Translational Medical Center of Pediatric Cataracts in Guangzhou City (201505032017516), and the National Key Research and Development Program (2017YFC1104600). The sponsors or funding organizations had no role in the design or conduct of this research.

Disclosure: **Q. Cao**, None; **X. Li**, None; **D. Lin**, None; **Z. Liu**, None; **J. Li**, None; **H. Jiang**, None; **Z. Lin**, None; **J. Chen**, None; **X. Wu**, None; **E. Long**, None; **Y. Lin**, None; **J. Tang**, None; **X. Chen**, None; **S. Huang**, None; **H. Lin**, None; **W. Chen**, None; **Y. Liu**, None

\*Qianzhong Cao and Xiaoyan Li contributed equally to this work and should be considered co-first authors.

## References

1. Lim Z, Rubab S, Chan YH, Levin AV. Pediatric cataract: the Toronto experience-etiology. *Am J Ophthalmol*. 2010;149:887–892.
2. Pi LH, Chen L, Liu Q, et al. Prevalence of eye diseases and causes of visual impairment in school-aged children in Western China. *J Epidemiol*. 2012;22:37–44.
3. Foster A, Gilbert C, Rahi J. Epidemiology of cataract in childhood: a global perspective. *J Cataract Refract Surg*. 1997;23(suppl 1):601–604.
4. Nie WY, Wu HR, Qi YS, et al. [A pilot study of ocular diseases screening for neonates in China]. *Zhonghua Yan Ke Za Zhi*. 2008;44:497–502.
5. Hu DN. Prevalence and mode of inheritance of major genetic eye diseases in China. *J Med Genet*. 1987;24:584–588.
6. Zhu JF, Zou HD, He XG, et al. Cross-sectional investigation of visual impairing diseases in Shanghai blind children school. *Chin Med J (Engl)*. 2012;125:3654–3659.
7. You C, Wu X, Zhang Y, Dai Y, Huang Y, Xie L. Visual impairment and delay in presentation for surgery in chinese pediatric patients with cataract. *Ophthalmology*. 2011;118:17–23.
8. Haargaard B, Nystrom A, Rosensvard A, Tornqvist K, Magnusson G. The Pediatric Cataract Register (PECARE): analysis of age at detection of congenital cataract. *Acta Ophthalmol*. 2015;93:24–26.
9. Pokharel GP, Negrel AD, Munoz SR, Ellwein LB. Refractive error study in children: results from Mechi Zone, Nepal. *Am J Ophthalmol*. 2000;129:436–444.
10. Maul E, Barroso S, Munoz SR, Sperduto RD, Ellwein LB. Refractive error study in children: results from La Florida, Chile. *Am J Ophthalmol*. 2000;129:445–454.
11. Zhao J, Pan X, Sui R, Munoz SR, Sperduto RD, Ellwein LB. Refractive error study in children: results from Shunyi District, China. *Am J Ophthalmol*. 2000;129:427–435.
12. Dandona R, Dandona L, Srinivas M, et al. Refractive error in children in a rural population in India. *Invest Ophthalmol Vis Sci*. 2002;43:615–622.
13. Murthy GV, Gupta SK, Ellwein LB, et al. Refractive error in children in an urban population in New Delhi. *Invest Ophthalmol Vis Sci*. 2002;43:623–631.
14. He M, Zeng J, Liu Y, Xu J, Pokharel GP, Ellwein LB. Refractive error and visual impairment in urban children in southern china. *Invest Ophthalmol Vis Sci*. 2004;45:793–799.
15. Naidoo KS, Raghunandan A, Mashige KP, et al. Refractive error and visual impairment in African children in South Africa. *Invest Ophthalmol Vis Sci*. 2003;44:3764–3770.
16. Resnikoff S, Pascolini D, Mariotti SP, Pokharel GP. Global magnitude of visual impairment

- caused by uncorrected refractive errors in 2004. *Bull World Health Organ.* 2008;86:63–70.
17. Castanon Holguin AM, Congdon N, Patel N, et al. Factors associated with spectacle-wear compliance in school-aged Mexican children. *Invest Ophthalmol Vis Sci.* 2006;47:925–928.
  18. Messer DH, Mitchell GL, Twelker JD, Crescioni M, Group CS. Spectacle wear in children given spectacles through a school-based program. *Optom Vis Sci.* 2012;89:19–26.
  19. Narayanan A, Kumar S, Ramani KK. Spectacle compliance among adolescents: a qualitative study from Southern India. *Optom Vis Sci.* 2017;94:582–587.
  20. von-Bischhoffshausen FB, Munoz B, Riquelme A, Ormeno MJ, Silva JC. Spectacle-wear compliance in school children in Concepcion Chile. *Ophthalm Epidemiol.* 2014;21:362–369.
  21. Lin HT, Luo LX, Chen WR, Liu YZ. Eye health is everyone's responsibility: China's first Western-style eye hospital improves in the prevention of blindness. *Int J Ophthalmol.* 2012;5:638–640.
  22. Horwood AM. Compliance with first time spectacle wear in children under eight years of age. *Eye (London).* 1998;12:173–178.
  23. Russell B, Ward MA, Lynn M, Dubois L, Lambert SR. The infant aphakia treatment study contact lens experience: one-year outcomes. *Eye Contact Lens.* 2012;38:234–239.
  24. Lambert SR, Lynn MJ, Hartmann EE, et al. Comparison of contact lens and intraocular lens correction of monocular aphakia during infancy: a randomized clinical trial of HOTV optotype acuity at age 4.5 years and clinical findings at age 5 years. *JAMA Ophthalmol.* 2014;132:676–682.
  25. Gordon RA, Donzis PB. Refractive development of the human eye. *Arch Ophthalmol.* 1985;103:785–789.