Journal of
Modern Rehabilitation

April 2023, Volume 17, Number 2

Research Article

Distribution Pattern of Refractive Errors in Strabismic Iranian Children

Haleh Kangari[1], Babak Masoomian[2], Masoud Khorrami-Nejad[2, 3*], Sarah Fawzi Hasan Alshmailawi[1], Faezeh Eidi[1]

1. Department of Optometry School of Rehabilitation, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
2. Translational Ophthalmology Research Center, Farabi Eye Hospital, Tehran University of Medical Sciences, Tehran, Iran.
3. Department of Optometry, School of Rehabilitation, Tehran University of Medical Sciences, Tehran, Iran.

Use your device to scan and read the article online

Citation: Kangari H, Masoomian B, Khorrami-Nejad M, Fawzi Hasan Alshmailawi S, Eidi F. Distribution Pattern of Refractive Errors in Strabismic Iranian. Journal of Modern Rehabilitation. 2023; 17(2):129-133. https://doi.org/10.18502/jmr.v17i2.12410

https://doi.org/10.18502/jmr.v17i2.12410

Article info:
Received: 25 Aug 2021
Accepted: 27 Oct 2021
Available Online: 01 Apr 2023

Keywords:
Refractive error; Strabismus; Hyperopia; Myopia; Astigmatism

Introduction: The purpose of the present study was to determine the refractive profile of strabismic children under 8 in a tertiary referral center in Tehran, Iran.

Materials and Methods: This retrospective cross-sectional study was conducted on the medical records of 357 patients under the age of 8 who had one type of strabismus in Farabi Hospital, Tehran, Iran, between 2015 and 2019. All routine ophthalmic examinations were done for all patients. Cycloplegic refraction was performed after the instillation of two drops of cyclopentolate 1% with an interval of 5 minutes, and the refractive error was measured after 30 minutes. The diagnostic criteria were based on cycloplegic refraction in which myopia, hyperopia, and astigmatism were defined when the refractive error was -0.25, +0.75, and -0.50 diopter (D) or more, respectively. The cycloplegic results were classified into different groups with an interval of 1.00 D, and astigmatism was also assessed separately.

Results: In this study, the most common type of refractive error in esotropic patients was hyperopia, with the +2.00 to +4.00 D range having a higher prevalence. In exotropic patients, hyperopia was also prevalent; the most common range of hyperopia was between +0.75 to +1.00 D. Astigmatism had a prevalence of 37.8% in esotropic patients, and 17.2% in exotropic patients with the most common range from -0.50 to -1.00. Myopia was present in 2.8% of patients with esotropia and 3.2 % of patients with exotropia with the most common range from -0.25 to -1.00.

Conclusion: In strabismic Iranian children, hyperopia was the most prevalent refractive error in both esotropic and exotropic patients, with higher degrees of hyperopia in esotropic patients. Low astigmatism was twice as prevalent in patients with esotropia as in patients with exotropia. Low myopia was the least prevalent in both esotropic and exotropia.

*** Corresponding Author:**
Masoud Khorrami-Nejad, PhD.
Address: *Department of Optometry, School of Rehabilitation, Tehran University of Medical Sciences, Tehran, Iran.*
Tel: *+98 (912) 3766221*
E-mail: *dr.khorraminejad@gmail.com*

1. Introduction

Strabismus and refractive error are visual development disorders beginning in childhood, but their sequelae frequently persist into adulthood. Globally, uncorrected refractive error accounts for up to 42% of visual impairment [1]. Refractive errors have become one of the leading causes of visual impairment and blindness, especially among children [2]. Strabismus, a condition in which the eyes are improperly aligned, can result in loss of binocularity and depth perception if left untreated [3]. The prevalence estimates for concomitant strabismus ranged from 2.3% to 6.0% in children [4-6] with significant psychosocial consequences [7]. Strabismus can be associated with refractive error, and both can lead to amblyopia [8, 9]. Amblyopia is the most important cause of unilateral visual impairment in children and adults under 60 years and accounts for 50% to 73% of all such vision loss [10, 11]. Early detection and intervention are necessary elements for improving visual acuity outcomes for amblyopic patients. Moreover, the younger age of the patient at early treatment has been proven to be associated with better treatment outcomes [12, 13].

Previous studies showed that certain types of refractive errors are associated with certain types of strabismus [14-16]. Children who were hyperopia in infancy are more likely to become strabismic [8]. Refractive accommodative esotropia is a consequence of childhood hyperopia frequently associated with moderate or high hyperopia [15, 17].

To better understand the distribution pattern of refractive error in Iranian strabismic children, this study was set up to evaluate the refractive profile of strabismic children under 8 years old in Farabi Eye Hospital, a tertiary referral center in Tehran, Iran, between 2015-2019.

2. Materials and Methods

This retrospective study examined the medical records of the patients referred to Farabi Eye Hospital, Tehran, Iran, from 2015 to 2019. This study was conducted on strabismic patients under the principles of the World Medical Association's Declaration of Helsinki. The Ethics Committee of Shahid Beheshti University of Medical Sciences approved the study protocol (IR.SBMU.RETECH.REC.1400.365). The sample size was 357 strabismic patients whose each eye's refractive error was evaluated separately.

In our hospital, firstly, general information such as name, age, and sex, as well as the history of previous eye examinations, wearing spectacle, eye patching, or ophthalmic surgery was considered. The family history of all mentioned information was also gathered from patients' medical records. Afterward, corrected and uncorrected distance visual acuity was recorded by the Snellen E chart.

The refractive errors were evaluated under cycloplegic conditions. Two drops of cyclopentolate eye drops were instilled at an interval of 5 minutes, and the exact amount of refractive error was measured after 30 minutes. The refractive error of each eye was measured by an auto refractometer (Topcon RM-8800, Topcon Corporation, Tokyo, Japan), and the results were confirmed by Heine Beta-200 streak retinoscope (Heine Optotechnik, Herrsching, Germany). The diagnostic criteria were based on cycloplegic refraction. Myopia, hyperopia, and astigmatism refractive errors were defined when the refractive error was greater than -0.25, +0.75, and -0.50 diopter (D), respectively [18]. The cycloplegic results were classified into different groups with an interval of 1.00 diopter, and astigmatism was also assessed separately. Alternate cover test, unilateral cover test (at far 6 m and near 40 cm), and Hirschberg and Krimsky tests were performed to evaluate the amount and the type of deviation.

SPSS software, version 24 (IBM Inc., Chicago, USA) was used to evaluate analytical calculations. Calculations of statistical indices, including Mean±SD, were made and shown in the Table. The graphs were drawn using the Microsoft Excel 2019 (Office 365; Microsoft Corporation, Redmond, WA) software.

3. Results

One hundred sixty-one (45.1%) patients were male, and 196(54.9%) were female. Two hundred and ninety-two (40.9%) patients were in the range of 3 months to 2 years. Six hundred forty-one (89.8 %) eyes had hyperopia. The most prevalent range of hyperopia was between +0.75 to +1.00 D which included 21.8% of the cases (Figure 1). After hyperopia, the most prevalent type of refractive error was astigmatism, in which 460(61.4%) eyes had astigmatism. The most prevalent range of astigmatism was between -0.50 to -1.00 D which included 45.5% of the patients. Finally, the prevalence of myopia was 6.9% which was the lowest frequency of refractive error, and the most prevalent range of myopia was between -0.25 to -1.00 D which included 2.1% of the patients. The distribution pattern of hyperopic and myopic refractive error in all strabismic, esotropic, and exotropia patients was shown in Figure 1 and Figure 2.

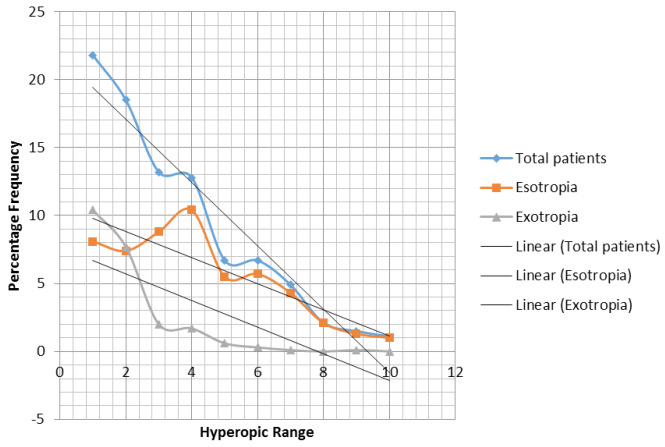

Figure 1. No. (%) of hyperopic refractive error in all strabismic, esotropic, and exotropic patients

Of these strabismic patients, 64.4% of patients had esotropia. Exotropia was found in 32.9% of the patients, and 2.7% of patients had a vertical deviation.

In esotropic patients, the prevalence of hyperopia was more than the other refractive errors, and accordingly, 53.9% of the samples were esotropic patients who had hyperopia. In addition, the most common range of hyperopia in esotropic patients was low to moderate values of hyperopia (+2.25 to +4.00 D). After hyperopia, astigmatism was the most prevalent refractive error in esotropic patients that included 37.8% of the cases, and also in this group, the most common range of astigmatism was between 0.00 to -1.00 D. The prevalence of myopia in esotropic patients was 2.8%, and the most common range was between -0.25 to -1.00 D.

In exotropic patients, hyperopia was also prevalent. It included 23.1% of the patients, and the most common range of hyperopia was between +0.75 to +1.00 D. After hyperopia, astigmatism was more prevalent among the exotropic patients and included 17.2% of the samples. Myopic patients included 3.1% of the patients in this group, and also the most common range of myopia was between -0.25 to -1.00 diopter.

4. Discussion

This study aimed to determine the refractive error distribution in different types of strabismus. In this study, the most common type of refractive error in esotropic patients was hyperopia, with a higher prevalence of +2.00 to +4.00 D range. These findings are similar to the Baltimore pediatric eye disease study (BPEDS) and multi-ethnic pediatric eye disease study (MEPEDS) findings. Both reports showed that hyperopia of +3.00 and more was the strongest predictor of esotropia [19]. These findings were similar to findings in Iraq and China [20, 21]. In esotropic patients, hyperopia was more prevalently seen in the +2.00 to +4.00 D range.

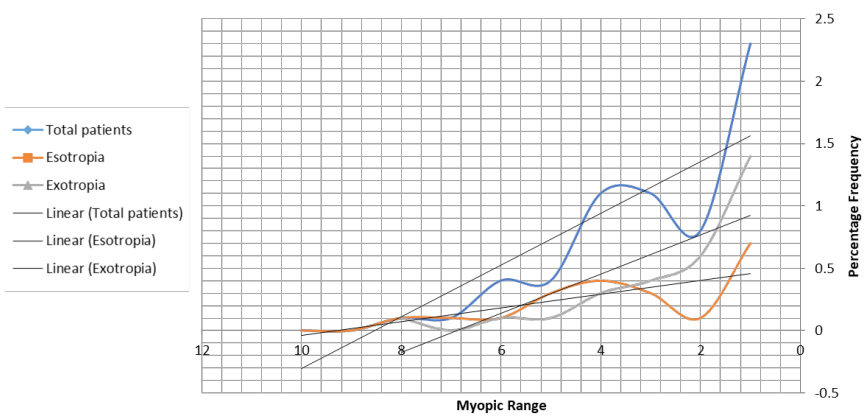

Figure 2. No. (%) of myopic refractive error in all strabismic, esotropic, and exotropic patients

In exotropic patients, hyperopia was also the most common type of refractive error, while the +0.75 to +2.00 D range had the highest prevalence. The myopic group was the least prevalent. These findings are similar to findings in Chinese children [21], whereas, in Chinese children, the odds of having myopic patients in the exotropia group were high. This difference could be due to differences in the sample age range. Our sample ranged from birth up to 8 years of age, with 40.9% of patients in the range of 3 months to 2 years, while in the study of Chinese children, the participants were in the age range of 3 to 6 years. The higher prevalence of hyperopia in our participants could be due to their younger age. The higher prevalence of myopic subjects in the Chinese population could also be due to a higher age and more myopic genes in their gene pool.

In exotropic patients, hyperopia was more prevalent. Astigmatism was twice as prevalent in esotropic patients as in exotropia patients, while the range of -0.50 to -1.00 D was the most common in both groups. In agreement with our findings, a study on the Indian population also showed that hyperopic astigmatism was the most prevalent type of astigmatism, found in esotropic patients, with almost twice the prevalence in the exotropia group [17]. Disputed results have been achieved in epidemiological studies on Chinese and American populations [19, 21]. In the Chinese study, astigmatism between -0.50 and -1.00 D was present more commonly in exotropic patients than in esotropic patients. The MEPEDS and BPEDS showed that astigmatism of 2.5 D and more was the strongest predictor of exotropia [19]. These differences could be due to the difference in the gene pool of different populations.

In Iranian children under 8 years of age, hyperopia was the most prevalent refractive error in both esotropic and exotropic patients, with higher degrees of hyperopia in esotropic patients. Low astigmatism was twice as prevalent in esotropic patients as in exotropic patients. Low myopia was the least prevalent in esotropia and exotropia. In addition, two essential points should be taken into consideration. Firstly, in hyperopic refractive error distribution, we have a lower prevalence of hyperopic refractive errors, more than +3.00 D in exotropic patients compared to the esotropic patients. Secondly, a higher prevalence of hyperopic refractive errors ranging between +3.00 to +4.00 D was seen in esotropic patients compared to the other amount of hyperopia. The higher prevalence of hyperopia calculated in esotropic patients would be due to the role of accommodative esotropia because moderate hyperopia is the most common type of refractive error in this type of strabismus patients.

This study had some limitations. The most important ones were the retrospective nature of the study and sampling from only one center.

In conclusion, among strabismic Iranian children, hyperopia was the most prevalent refractive error in both esotropic and exotropic patients, with higher degrees of hyperopia in esotropic patients. Low astigmatism was twice as prevalent in esotropic patients as exotropic patients. Low myopia was the least prevalent in both esotropic and exotropia.

Ethical Considerations

Compliance with ethical guidelines

This study was conducted on strabismic patients under the principles of the World Medical Association's Declaration of Helsinki. The Ethics Committee of Shahid Beheshti University of Medical Sciences approved the study protocol (Code: IR.SBMU.RETECH.REC.1400.365).

Funding

This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors' contributions

Conceptualization, supervision, project administration, resources, software, validation, visualization, writing – original draft, review & editing: Haleh Kangari, Babak Masoomian, and Masoud Khorrami-Nejad, Data curation: Babak Masoomian and Masoud Khorrami-Nejad, Formal analysis: Masoud Khorrami-Nejad Investigation and Methodology: Haleh Kangari, Babak Masoomian, Masoud Khorrami-Nejad and Faezeh Eidi.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgments

The authors would like to thanks the head of strabismus clinic, Akbari and all ophthalmologist, optometrists and staff on strabismus clinic in the Farabi Eye Hospital.

References

[1] Pascolini D, Mariotti SP. Global estimates of visual impairment: 2010. British Journal of Ophthalmology. 2012; 96(5):614-8. [DOI:10.1136/bjophthalmol-2011-300539] [PMID]

[2] Dandona R, Dandona L. Refractive error blindness. Bulletin of the World Health Organization. 2001; 79:237-43. [Link]

[3] Carlton J, Karnon J, Czoski-Murray C, Smith K, Marr J. The clinical effectiveness and cost-effectiveness of screening programs for amblyopia and strabismus in children up to the age of 4-5 years: A systematic review and economic evaluation. Health Technology Assessment. 2008; 12(25):iii, xi-194. [DOI:10.3310/hta12250] [PMID]

[4] Tang SM, Chan RY, Lin SB, Rong SS, Lau HH, Lau WW, et al. Refractive errors and concomitant strabismus: A systematic review and meta-analysis. Scientific Reports. 2016; 6(1):1-9. [DOI:10.1038/srep35177] [PMID] [PMCID]

[5] Group M-ePEDS. Prevalence of amblyopia and strabismus in African American and Hispanic children ages 6 to 72 months: The multi-ethnic pediatric eye disease study. Ophthalmology. 2008; 115(7):1229-36. [DOI:10.1016/j.ophtha.2007.08.001] [PMID] [PMCID]

[6] Khorrami-Nejad M, Akbari MR, Khosravi B. The prevalence of strabismus types in strabismic Iranian patients. Clinical Optometry. 2018; 10:19. [DOI:10.2147/OPTO.S147642] [PMID] [PMCID]

[7] Buffenn AN. The impact of strabismus on psychosocial health and quality of life: A ystematic review. Survey of Ophthalmology. 2021; 66(6):1051-64. [DOI:10.1016/j.survophthal.2021.03.005] [PMID]

[8] Smith III EL, Hung L-F, Arumugam B, Wensveen JM, Chino YM, Harwerth RS. Observations on the relationship between anisometropia, amblyopia, and strabismus. Vision Research. 2017; 134:26-42. [DOI:10.1016/j.visres.2017.03.004] [PMID] [PMCID]

[9] Wang Y, Xu Y, Liu X, Lou L, Ye J. Amblyopia, strabismus and refractive errors in congenital ptosis: A systematic review and meta-analysis. Scientific Reports. 2018; 8(1):1-9. [DOI:10.1038/s41598-018-26671-3] [PMID] [PMCID]

[10] Robaei D, Huynh SC, Kifley A, Mitchell P. Correctable and non-correctable visual impairment in a population-based sample of 12-year-old Australian children. American Journal of Ophthalmology. 2006; 142(1):112-8. [DOI:10.1016/j.ajo.2006.02.042] [PMID]

[11] Wang JJ, Foran S, Mitchell P. Age-specific prevalence and causes of bilateral and unilateral visual impairment in older Australians: The blue mountains eye study. Clinical & Experimental Ophthalmology. 2000; 28(4):268-73. [DOI:10.1046/j.1442-9071.2000.00315.x] [PMID]

[12] Gopal SK, Kelkar J, Kelkar A, Pandit A. Simplified updates on the pathophysiology and recent developments in the treatment of amblyopia: A review. Indian Journal of Ophthalmology. 2019; 67(9):1392. [DOI:10.4103/ijo.IJO_11_19] [PMID] [PMCID]

[13] Holmes JM, Levi DM. Treatment of amblyopia as a function of age. Visual Neuroscience. 2018; 35:E015. [DOI:10.1017/S0952523817000220] [PMID]

[14] Tang SM, Chan RY, Bin Lin S, Rong SS, Lau HH, Lau WW, et al. Refractive errors and concomitant strabismus: A systematic review and meta-analysis. Scientific Reports. 2016; 6:35177. [DOI:10.1038/srep35177] [PMID] [PMCID]

[15] Donnelly UM. Horizontal strabismus worldwide--what are the risk factors? Ophthalmic Epidemiol. 2012; 19(3):117-9. [DOI:10.3109/09286586.2012.681002] [PMID]

[16] Chia A, Dirani M, Chan YH, Gazzard G, Au Eong KG, Selvaraj P, et al. Prevalence of amblyopia and strabismus in young Singaporean Chinese children. Investigative Ophthalmology & Visual Science. 2010; 51(7):3411-7. [DOI:10.1167/iovs.09-4461] [PMID] [PMCID]

[17] Lambert SR. Accommodative esotropia. Ophthalmology Clinics of North America. 2001; 14(3):425-32. [DOI:10.1016/S0896-1549(05)70240-6] [PMID]

[18] Khorraminejad M, Akbari MR, Ranjbarpazooki M, Aghazadehamiri M, Askarizadeh F, Moeinitabar M, et al. The prevalence of refractive errors and binocular anomalies in students of deaf boys schools in Tehran. Iranian Journal of Ophthalmology. 2014; 26(4):183–8. [Link]

[19] Cotter SA VR, Tarczy-Hornoch K, McKean-Cowdin R, Lin J, Wen G, Wei J, et al. Risk factors associated with childhood strabismus: The multi-ethnic pediatric eye disease and Baltimore pediatric eye disease studies. Ophthalmology. 2011; 118((11)):2251-61. [DOI:10.1016/j.ophtha.2011.06.032] [PMID] [PMCID]

[20] Abady NH, Al-jumaili AA, Fayyadh RA. Association between strabismus and refractive errors among preschool children in Fallujah, Iraq. Indian Journal of Public Health Research & Development. 2019; 10(5):508-13. [Link]

[21] Zhu H, Yu JJ, Yu RB, Ding H, Bai J, Chen J, et al. Correction: Association between childhood strabismus and refractive error in Chinese preschool children. Plos One. 2015; 10(6):e0130914. [DOI:10.1371/journal.pone.0130914] [PMID] [PMCID]