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Distribution of Binocular Vision Anomalies and Refractive Errors in Iranian Children With Learning Disabilities

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Abstract

Background: Visual problems in children contribute to learning disorders, which are one of the most influential factors in learning.
Objectives: The aim of the present study was to determine the prevalence of refractive and binocular vision errors in children with learning disorders.
Patients and Methods: In this cross-sectional study, 406 children with learning disorders with a mean age of 8.56 ± 2.4 years were evaluated. Examinations included the determination of refractive errors with an auto-refractometer and static retinoscopy, measurement of visual acuity with a Snellen chart, evaluation of ocular deviation, and measurement of stereopsis, amplitude of accommodation, and near point of convergence.
Results: Of the 406 participants, 319 (78.6%) were emmetropic in the right eye, 14.5% had myopia, and 6.9% had hyperopia according to cycloplegic refraction. Astigmatism was detected in 75 (18.5%) children. In our study, 89.9% of the children had no deviation, 1.0% had esophoria, and 6.4% had exophoria . In addition, 2.2% of the children had suppression. The near point of convergence ranged from 3 to 18 cm, with a mean of 10.12 ± 3.274 cm. Moreover, 98.5 and 98.0% of the participants achieved complete vision with the best correction in the right and left eye, respectively. The best corrected visual acuity in the right and left eye was achieved in 98.5 and 98.0% of the children, respectively.
Conclusions: The pattern of visual impairment in learning-impaired children is not much different from that in normal children; however, because these children may not be able to express themselves clearly, lack of correct diagnosis and appropriate treatment has resulted in a marked defect in recognizing visual disorders in these children. Therefore, gaining knowledge of the prevalence of refractive errors in children with learning disorders can be considered the first step in their treatment.

Keywords: Refractive Errors, Binocular Vision, Learning Disorder, Child, Prevalence, Iran

1. Background

WHO statistics indicate that 2% of the world population suffers from some degree of mental retardation. This is particularly important because 80% of these people are below the age of 18 years; therefore, careful evaluation of their condition may improve their quality of life and educational status in the future (1). On the other hand, the high prevalence of ocular anomalies, strabismus, astigmatism, and lack of convergence in these individuals, along with their 52% incidence rate of refractive errors, and other auditory and cognitive problems have made correction and improvement of their visual conditions an important factor in enhancing their learning abilities and improving their quality of life (2). However, due to a lack of understanding of and emphasis on the healthcare system and limitations in trained personnel, lack of accurate statistics, and the difficulty of learning-impaired children to express their problems, children with learning disorders use treatment services very rarely (3-5). A review of the literature shows that 89% of adults with learning disorders have no past records of ocular examination (6). All the aforementioned factors, along with the necessity of evaluating visual disorders in these children, underline the need for the healthcare system to understand the needs of children with learning disorders in order to plan screening programs and identify the best strategies for prevention and treatment.

2. Objectives

Considering the above-mentioned points and the lack of relevant research on children in Iran, we investigated the prevalence of different visual disorders and refractive errors in children with learning disorders.

3. Patients and Methods

This cross-sectional study was performed in Tehran in 2014. The target population of the study was children with learning disorders. The samples were selected from schools and related learning centers through randomized cluster sampling. After selecting the centers through simple randomization, a number of children were randomly selected from each center.

Parental consent to participate in the study, learning disorder documentation using the Wechsler test, average IQ (more than 80), lack of mental disorders, and age above five years were the inclusion criteria of the study. Subjects with a previous history of ocular surgery were excluded from the study.

In the first step, after identification of the patients that were registered in the centers, their parents were contacted and provided with necessary information regarding the methodology and objectives of the project. The patients were then referred to the clinic for examinations upon parental consent. The children were visited and examined in the clinic after obtaining their parents' consent in writing and after registering their data.

First, the children underwent auto-refractometry and static retinoscopy to measure their refractive error. Then, their visual acuity was measured using a Snellen chart at 6 m. A cover test was then performed, followed by the measurement of stereopsis using the Titmus test, amplitude of accommodation using the near chart (0.8), and near point of convergence. Finally, cycloplegic drops were administered three times at five-minute intervals in both eyes of each child, and cycloplegic refraction was performed after 45 minutes.

3.1. Definitions

We set the spherical equivalent based on cycloplegic refraction cut-points of −0.50 diopter (D) for myopia and +1.0 D for hyperopia, and astigmatism was defined as a cylinder power of 0.75 D or less registered as a negative value.

We evaluated ocular deviation using a cover test and suppression based on the Titmus test, and amplitude of convergence was evaluated using a diopter and a near Snellen chart (10/10) with the push up method. Also, near point of accommodation was assessed using a flash light when the light became double and anisometropia resulted based on the diameter (cm) from nose. Amblyopia was defined as a best corrected visual acuity (BCVA) of 20/30 or less or two-line intraocular optotype acuity differences with no pathology. The severity of amblyopia was defined as a BCVA less than 20/40 in both eyes.

3.2. Ethical Issues

The ethics committee of the Mashhad university of medical sciences approved the study protocol, which was designed in accordance with the Helsinki declaration.

4. Results

We evaluated 406 children with learning disorders, of whom 271 (66.7%) were male. The mean age of the participants was 8.56 ± 2.4 years, ranging from 5 - 14 years. Among the participants, 65 (16%) were myopic, 35 (8.6%) were hyperopic, and 75 (18.5%) were astigmatic. The prevalences of with the rule and oblique astigmatism were 8.4% and 3%, respectively. Spherical and cylinder error in the right and left eyes were measured with astigmatic scores. Moreover, 1.0% of the children had esophoria, 6.4% had exophoria, and nine (2.2%) were diagnosed with suppression. The mean amplitude of accommodation was 15.53 D in the right eye and 15.52 D in the left eye. The mean near point of convergence was 10.12 cm (SD = 3.274), with a range of 3 - 18cm. Severe and mild amblyopia were observed in one and four children, respectively. One child was not cooperative, and 400 children (98.5%) had a visual acuity of 10/10. Evaluation of the visual acuity of both eyes with the best correction showed that in the right eye, one child had a visual acuity of 1/10 (unilateral amblyopia), two children had a visual acuity of 8/10, two children had a visual acuity of 9/10, and the rest (n = 400, 98.5%) had a visual acuity of 10/10. In the left eye, one child had a visual acuity of hand motion (unilateral amblyopia), two children had a visual acuity of 8/10, two had a visual acuity of 9/10, and the remaining had a visual acuity of 10/10 with the best correction.

5. Discussion

We evaluated the distribution and percentage of refractive errors in Iranian children with learning disorders. According to the results, the prevalences of myopia, hyperopia, and astigmatism in these children were 16%, 8.6%, and 18.5%, respectively. Watts et al. used the medical technology and innovations (MTI) photoscreeners to investigate refractive errors in these children and reported prevalence rates of 21.1, 13.2, and 31.5% for myopia, hyperopia, and astigmatism, respectively (5). The difference between the results reported by Watts and our findings could be due to measurement differences of the various devices. The definition of refractive error is another reason for the difference; some studies use +1.5 DS as a base in their measurements (7). Woodhouse et al. performed a study on children with learning disorders with no restrictions on intelligence quotient (IQ) in 2000 and reported that 41% of the 148 participants were hyperopic, 56% required myopic correction, and most of them lacked appropriate glasses (6). In 2000, Garzia et al. confirmed a prevalence of 15 - 20% for ocular problems, especially refractive errors, in these individuals (8). Sherman also reported a

maximum prevalence of 16% for refractive errors in these children (6 - 13 years old) in 1973 (9).

Comparison of our results regarding refractive errors and amblyopia with those of normal children demonstrates no marked difference except in certain ethnic groups or outside the designated age range. However, it should be noted that refractive errors have more common ground with accommodation defects than with learning disorders (10). Blika et al. compared visual acuity, phoria, and stereopsis in 41 primary school students with reading difficulties and 200 normal children and reported similar results (11). In Germany, Jobke et al. conducted a study on children aged 7 - 11 years and found prevalence rates of 5.5% and 6.4% for myopia and hyperopia, respectively (12). In the US, Kleinstein reported a prevalence of 12.8% for myopia in children aged 5 - 17 years in 2003 (13). On the other hand, studies have shown that myopia can make by learning activity without any significant difference between children and adults (14).

Laatikainen evaluated 411 students aged 5 - 11 years and reported a frequency of 19.1% for hyperopic and 21.8% for myopic eyes, with a difference of 10.5% in hyperopia between this report and our results (15). The prevalence of amblyopia was reported as 1.7% in children entering primary school in a study by Jamali et al. (16).

In our study, there was no difference in the distributions of myopia, hyperopia, and astigmatism between boys and girls (difference in myopia = 0.4%, in hyperopia = 5.1%, and in astigmatism = 1.1%). We also found prevalences of 10.1% and 9.6% in the right and left eye for strabismus (tropia and phoria), respectively. Aasved et al. reported a prevalence of about 7.1% for strabismus (10), and Watts et al. reported a prevalence of 7.8%, which is very similar to our results (5). However, none of the studies have addressed gender distribution.

The prevalence of suppression was 2.2% in our study. Aasved et al. reported a prevalence of 10.1% for central suppression (10).

Patients with learning disorders may have a broad spectrum of underlying diseases, such as seizures, Down's syndrome, and cerebral palsy, which have secondary effects on vision. In a study in India, 45.3% of the children with learning disorders had the above-mentioned underlying diseases, 27.3% had refractive errors, and 15.7% had strabismus (17). It can be concluded that visual disorders are multifactorial.

The mean amplitude of accommodation was 14.53 D in the right and 14.52 D in the left eye, with no significant difference between boys and girls. Considering the mean age of 9.12 years in this study, this amplitude of accommodation indicates a lack of about 1 D, which has also been addressed in studies by Garzia and the statement of American association of ophthalmology (8, 18). In our study, the prevalence of visual acuity less than 9/10 with the best correction was 1.5% in the right eye and 2% in the left eye. The prevalence of visual acuity less than 6/9 was 5.2% in the study performed by Aasved et al. (10), and the prevalence of visual acuity less than 60/6 was reported to be 3.8% in a study by Nielsen et al. (19). The mean near point of convergence was 10.12 cm in our study, which is in line with the results of other studies, confirming decreased convergence in these children. The prevalence of phoria was 7.4% in our study and 46.3% in the study by Aasved et al. (10). Although the difference is noticeable, it should be noted that the age range of the participants was 6 - 18 years in the latter study.

Finally, it should be noted that despite the evidence of visual problems in children with learning disorders, no marked difference was observed when these children were compared to normal children. It seems that the main problem for these children is the inability to appropriately express their ocular problems to their parents. Although visual problems are not the main cause of learning disorders, they, together with lack of communication from the patient, can aggravate the symptoms of learning disorders or cause difficulties in the treatment process. In general, evaluation of these patients prevents resources from being wasted; therefore, screening programs are necessary (5).

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Footnotes

Authors' Contribution: Study concept and design: Abbas Ali Yekta, Hassan Hashemi, Zahra Shadalouee; analysis and interpretation of data: Mehdi Khabazkhoob; drafting of the manuscript: Saman Mohazzab-Torabi; critical revision of the manuscript for important intellectual content: Abbas Ali Yekta, Hassan Hashemi, Zahra Shadalouee, Hadi Ostadimoghaddam, Saman Mohazzab-Torabi, Mehdi Khabazkhoob, Negareh Yazdani, Nooshin Dadbin, and Azam Malekifar; statistical analysis: Mehdi Khabazkhoob.

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