



Original research

Behavior disorders in children with significant refractive errors

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Abstract

Purpose: To evaluate the frequency of behavioral disorders in children with significant refractive error and to compare the results with those of emmetropic children.

Methods: In this prospective, comparative study from January to September 2013, refractive errors of all 5–12-year-old children who referred to a general eye clinic were recorded. A validated Persian version of the Rutter A scale was filled out by the parents for the evaluation of the child's behavioral disorders. The Rutter A scale scores of children with significant refractive error were compared with those of emmetropic eyes. Student t test, Chi square test, and Fisher's exact test were used for analysis. Differences with a P value less than 0.05 were considered significant.

Results: One hundred eighty-three patients, including 101 patients with significant refractive error and 82 emmetropic subjects, were studied. Overall, 44 patients (24%) had behavioral disorders, according to the Rutter A scale scores. Thirty patients (29.7%) with significant refractive error and 14 emmetropic subjects (16.9%) had behavioral disorders ($P = 0.043$). The prevalence of behavioral disorders were 37.5% in hyperopia, 35.7% in hyperopia-astigmatism, 21.4% in simple astigmatism, 16.7% in myopia-astigmatism, and 14.3% in myopia. Compared with emmetropic subjects, the prevalence of behavioral disorders was statistically significantly higher only in patients with hyperopia and hyperopia-astigmatism ($P = 0.019$ and $P = 0.040$).

Conclusion: The prevalence of behavioral disorders is higher in children with hyperopia and hyperopia-astigmatism.

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Keywords: Refractive errors; Behavioral disorder; Hyperopia; Hyperopia astigmatism

Introduction

Childhood behavioral disorders consist of a large group of behavior and mental conditions with reported incidence of 10–26% in different parts of the world.¹ Pediatric behavioral disorders have a negative effect on education and social functioning and may end in premature termination of education, anti-social behaviors, and substance abuse.^{2,3} Environmental

and biological factors may have a causative and predisposing role for childhood behavioral disorders, and higher incidences have been shown in some physical diseases and disabilities.^{4,5}

High refractive errors in children may be associated with blurred vision, eye strain, ocular pain, headache, and even amblyopia and strabismus.⁶ Children with high refractive errors may have intellectual disabilities, incompatibility in school and society, and less interest for education.^{6,7} Previous studies have reported a higher incidence of child behavioral disorders in visually impaired children and those with convergence insufficiency.^{5,7,8} To the best of our knowledge, there is no report on the incidence of behavioral disorders in school children with significant refractive errors.

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The purpose of this study was to evaluate the frequency of behavioral disorders in 5–12-year-old children who have significant refractive errors.

Methods

In this case–control study between January to September 2013, all 5–12-years old children who were examined in a private general eye clinic in Tehran were evaluated. The study was approved by the Iran University of Medical Sciences Eye Research Center Ethics Committee, and informed consents were obtained.

Complete ophthalmic examination including evaluation of best corrected visual acuity, manifest and cycloplegic refraction, ocular motility, and slit lamp and dilated fundus examination was performed. Children with chronic systemic or ocular diseases, psychiatric drug use, or history of trauma were excluded. Also, patients with any structural ocular disease were excluded.

For cycloplegic refraction, one drop of cyclopentolate 1% was instilled in both eyes and repeated after 5 min. After 45 min, the average of at least 3 auto-refraction of each eye was recorded using a Topcon 7000 A autorefractometer (Topcon Inc. Japan).

Significant refractive error was defined according to the American Association for Pediatric Ophthalmology and Strabismus (AAPOS) Vision Screening Committee criteria.⁹ Based on cyclorefraction, the hyperopic group consisted of the spherical equivalent of $\geq +3.50$ diopters (D), the myopic group was considered as eyes with a spherical equivalent ≤ -3.00 D, and the astigmatic group consisted of eyes with the astigmatism more than 1.50D in vertical meridian ($90' \pm 20$) or horizontal meridian ($180' \pm 20$) or more than 1.00 D in oblique meridian ($20' - 70'$ or $110' - 160'$). The eyes were considered emmetropic if spherical equivalent of refractive error or astigmatism were between -1.00 D and $+1.00$ D. Included eyes should have bilaterally the same type of significant refractive errors.

For each child, one of the parents completed a validated Persian translation of Rutter's children's behavior questionnaire for evaluation (Rutter A Scale). Rutter A Scale has 31 questions in total and is divided into three sections. The first section has eight questions about somatic problems and truancy from school; the second section has five questions about difficulties in speech, eating, and sleeping; and the third section consists of 18 descriptions of abnormal behaviors. The parents

were asked to indicate '0 = does not apply' or '1 = applies somewhat' or '2 = definitely applies' for each question. The total scores were calculated, and scores greater than 13 indicated behavioral disorder.¹⁰ Validity of this translated questionnaire has been previously shown in Iran.¹¹

Data were analyzed using SPSSs software (version 21, SPSS, IBM Inc., Chicago, IL). Student t test, Chi square test, and Fisher's exact test were used for analysis. Differences with a P value less than 0.05 were considered significant.

Results

Overall, 183 subjects including 101 cases with significant refractive error (refractive group) and 82 emmetropic cases (emmetropic group) were evaluated. Table 1 shows characteristics of the subjects. The sex and age were statistically similar between the two groups ($P = 0.558$ and $P = 0.318$, respectively).

Based on the Rutter A Scale scores, 44 children (24%) had behavioral disorders (Table 1). Of these, 30 cases (68.2%) were in the refractive group, and 14 cases (31.8%) in the emmetropic group ($P = 0.043$, odds ratio 2.05 with a 95% confidence interval of 1.003–4.201).

Subgroup analysis revealed behavioral disorders in 1 of 7 myopic (14.3%), 12 of 32 hyperopic (37.5%), 6 of 28 simple astigmatic (21.4%), 1 of 6 myopia-astigmatic (16.7%), and 10 of 28 hyperopia-astigmatic (35.7%) subjects. The difference was statistically significant for hyperopia and hyperopia-astigmatic groups ($P = 0.019$ and $P = 0.040$, respectively, Table 2).

Discussion

Our study showed that the rate of behavioral disorder based on the Rutter A scale questionnaire is higher in children with significant refractive error. The Rutter questionnaires consist of two sets of questions which give an index of behavioral disorders in children. The Rutter scale questionnaire "A" was completed by one of the parents, and the scale "B" was completed by the teacher. In our clinic, children referred from different parts of the city, and access to the teachers was difficult. Therefore, we chose scale A for evaluation of the child's behavioral disorders. Several studies confirmed the validity of the questionnaire in different countries, including Iran.^{10–12} We found a rate of 17% for behavioral disorders in emmetropic children. This rate is similar to the rate reported

Table 1
Characteristics of subjects with significant refractive error compared with emmetropics. The P values were calculated to compare the significant refractive error group and emmetropic group.

| | All cases | Significant refractive error group | Emmetropic group | P value |
|---------------------------------------------------------------|-----------------|------------------------------------|------------------|---------------------|
| Number | 183 | 101 | 82 | – |
| Age (year) ^a | 8.26 \pm 2.21 | 8.41 \pm 2.39 | 8.08 \pm 1.97 | 0.318 ^b |
| Sex (male/female) | 105/78 | 56/45 | 49/33 | 0.558 ^c |
| Spherical equivalent refractive error (Diopters) ^a | 0.55 \pm 0.49 | 2.10 \pm 3.49 | 0.25 \pm 0.30 | <0.001 ^b |
| Rutter A Scale score ^a | 8.60 \pm 6.89 | 9.53 \pm 7.15 | 7.45 \pm 9.53 | 0.039 ^b |
| Abnormal Rutter A Scale score | 44 (23.9%) | 30 (29.7%) | 14 (17.1%) | 0.043 ^c |

^a Mean \pm standard deviation.

^b t test.

^c Chi square test.

Table 2

Characteristics of subjects in different subgroups of patients with significant refractive error. The P values were calculated in comparison to emmetropic subjects.

| | Hyperopic group | Myopic group | Simple astigmatic group | Myopia astigmatic group | Hyperopia astigmatic group |
|------------------------------------------|------------------------|------------------------|-------------------------|-------------------------|----------------------------|
| Number | 32 | 7 | 28 | 6 | 28 |
| Age (year) ^a | 8.34 ± 2.45 | 8.85 ± 2.85 | 8.71 ± 2.53 | 8.00 ± 1.26 | 8.07 ± 1.97 |
| | P = 0.567 ^b | P = 0.341 ^b | P = 0.180 ^b | P = 0.917 ^b | P = 0.838 ^b |
| Sex (male/female) | 21/11 | 4/3 | 15/13 | 2/4 | 14/14 |
| | P = 0.560 ^c | P = 0.960 ^d | P = 0.571 ^c | P = 0.210 ^d | P = 0.372 ^c |
| Refractive error (diopters) ^a | 4.50 ± 1.42 | -3.31 ± 0.77 | -0.11 ± 1.07 | -5.11 ± 1.67 | 4.68 ± 1.68 |
| Rutter A Scale score ^a | 10.19 ± 7.87 | 10.44 ± 5.44 | 7.57 ± 6.35 | 7.65 ± 5.70 | 10.93 ± 7.60 |
| | P = 0.058 ^b | P = 0.237 ^b | P = 0.932 ^b | P = 0.936 ^b | P = 0.020 ^b |
| Abnormal Rutter A Scale score | 12 (37.5%) | 1 (14.3%) | 6 (21.4%) | 1 (16.7%) | 10 (35.7%) |
| | P = 0.019 ^c | P = 0.852 ^d | P = 0.610 ^c | P = 0.980 ^d | P = 0.040 ^c |

^a Mean ± standard deviation.

^b t test.

^c Chi square test.

^d Fisher's exact test.

by previous screening studies in different countries (4–23%).^{1,13–16} The rate of behavioral disorders in our study was higher in the hyperopic and hyperopia-astigmatic groups (37.5% and 35.7%, respectively).

Two studies reported refractive error of children with attention deficit hyperactivity disorder (a subtype of behavior disorder) and yielded conflicting results. Mezer and Wygnanski-Jaffe¹⁷ evaluated ocular features in a series of children with attention deficit hyperactivity disorder and reported significant ametropia in 42 children (83%). Conversely, Fabian et al.¹⁸ reported children with attention deficit hyperactivity disorder had similar refractive errors as normal subjects.

There is no clear explanation for the higher rates of behavior disorders in children with significant refractive error, especially those with hyperopia and hyperopia-astigmatism. It is known that various brain centers and cortical networks control both visual function and behavior. Dysfunction of a part of the brain may affect other functions, such as attention, through unknown center and pathways.¹⁹ Alternatively, behavioral disorders and refractive error may have a common genetic predisposition.^{19–21}

The present study has several limitations. The sample size is small, and the study population may not represent the true urban population. The small number of children in some subgroups may explain the statistically non-significant results. The Rutter questionnaire is a screening tool and has not been designed to detect a specific behavioral disorder such as attention-deficit/hyperactivity disorder, oppositional defiant disorder, etc. Clinical examination is the standard of care for the detection of the specific behavioral disorder. Further studies with a larger sample size are needed to confirm the findings of our study.

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