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Ophthalmological findings in children and adolescents with attention deficit and hyperactivity disorder

Abstract

Purpose: Although ADHD, one of the most common neuropsychiatric disorders in children, and visual impairments both are known to be caused by genetic factors and frequently seen together; studies regarding vision problems in children and adolescents with ADHD are limited. The aim of this study is to determine whether there are any differences in terms of refractive errors and some other ophthalmological findings between children and adolescents with ADHD and healthy controls.

Method: Children and adolescents aged 8-16 years (n=64) with ADHD diagnosis (untreated and had no chronic medical disorder) and a control group of healthy children and adolescents of the same age (n=60) were included in the study. Patients were examined in the Ophthalmology Department of Ahi Evran University Research and Training Hospital for the refractive errors, presence of wearing glasses, presence of allergic conjunctivitis and intraocular pressure.

Results: The groups were similar in terms of age and gender. The rate of refractive errors was 18.75% and 6.66% in the ADHD group and the control group, respectively. The rate of the presence of Allergic Conjunctivitis was 62.5% in ADHD group while 28.3% in the control group. Patients with ADHD had significantly higher rates of refractive errors and presence of allergic conjunctivitis. When the use of eyeglasses was examined; the rate of wearing glasses in the control group was 75%, whereas it was 66.6% in the ADHD group. When the groups were evaluated in terms of intraocular pressure; mean intraocular pressure was 14.57±1.57 mmHg in the ADHD group and 15.15±2.23 mmHg in the control group. There were no significant differences in terms of the use of eyeglasses (p=0.755) and intraocular pressure (p=0.095) between the groups. Although the need for eyeglasses, the rate of not wearing glasses was higher in ADHD patients compared to controls, but this difference was not statistically significant. It was found that the refractive errors for boys increased compared to girls when children and adolescents with ADHD were divided into two groups according to gender. This difference according to gender was nearly statistically significant (p=0.061). The difference regarding presence of allergic conjunctivitis was not observed between boys and girls.

Conclusion: Our findings suggest that the need for eyeglasses in children and adolescents with ADHD was increased compared to healthy counterparts. Therefore, it is important to refer children and adolescents admitted to the Child Psychiatry Clinic with attention deficit complaints to the specialist for ophthalmologic examination for possible refractive errors.

Keywords: neuropsychiatric disorders, hyperactivity disorder, neurotransmitter system, visual impairments, ocular disorders, pediatric patients

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Introduction

Attention Deficit and Hyperactivity Disorder (ADHD) is one of the most common psychiatric disorders of childhood, characterized by hyperactivity, impulsivity and inattention inappropriate with person's developmental level. ADHD negatively affects academic performance and peer and family interactions of children and adolescents.[1] ADHD is classified in neurodevelopmental disorders[2] and a multifactorial disorder with especially genetic factors in its etiology.[3] The prevalence of the disorder is reported to be 3,4% (2,6–4,5) in the world.[4]

In recent years, genetic factors and the effect of the dopamine neurotransmitter system have been discussed in the development of both schizophrenia and refractive errors.[5] Genetic factors play an important role also in the development of ADHD, which is one of the most common psychiatric disorders in children. Neurodevelopmental approaches suggest that prefrontal cortex maturation is delayed in children with ADHD.[6] According to the neurochemical hypothesis explaining ADHD, dopamine neurotransmitter is the most emphasized neurotransmitter. Studies have shown that dopamine receptor density is lower in patients with ADHD in multiple brain regions than in healthy controls.[7–9] There are several studies investigating ocular findings in various neuropsychiatric diseases including ADHD in children and adolescents,[10–13] However there are limited number of studies investigating the relationship between ADHD and visual impairments.[14–17]

Allergic conjunctivitis is one of the most common ocular disorders in pediatric patients and defined as a Type 1 hypersensitivity reaction in which the IgE mediated response is involved. There are different types of allergic conjunctivitis such as acute, subacute allergic conjunctivitis, vernal and atopic keratoconjunctivitis. Acute allergic conjunctivitis is a common acute conjunctival reaction in children, which usually develops in spring and summer due to environmental allergens such as pollen.[18] Previous studies suggested that the sustained and exaggerated release of proinflammatory mediators might be affect the brain regions responsible for executive functions associated with ADHD.[19]

It was aimed in our study to determine the refractive errors and some other examination parameters including presence of allergic conjunctivitis in children and adolescents with ADHD.

Material and methods

The data obtained from the measurements of 128 eyes of 64 patients with ADHD and 120 eyes of 60 healthy controls. Patients were recruited from Ahi Evran University Training and Research Hospital Child Psychiatry Clinic in March-September 2018. Patients who were aged 8–16 years, first diagnosed with ADHD (combined subtype) and have not received any treatment were included. The diagnosis of ADHD was clarified by Child and Adolescent Psychiatrist by using K-SADS-PL (Kiddie Schedule for Affective Disorders and Schizophrenia Present and Lifetime Version), a semi-structured diagnostic interview tool. Healthy controls who admitted to Child Psychiatry Department because of minor psychological problems were recruited. The exclusion criteria were presence of mental retardation, pervasive developmental disorders, significant neurological illness and chronic medical illness. Two girls with ADHD have not been participated in the study because of the epilepsy diagnosis.

The patients were evaluated in the Ophthalmology outpatient clinic for the refractive errors, use of eyeglasses, presence of allergic conjunctivitis and intraocular pressure (mmHg). Allergic conjunctivitis diagnosis was based on detailed history (episodic, seasonal, symptoms consist of itching, burning, watering) and ophthalmic examiation by biomicroscope (papillary reaction in upper tarsal conjunctiva or stringy discharge). Intraocular pressure was measured by non-contact tonometer. The research was carried out in accordance with Helsinki declaration rules and by receiving informed consent forms of patients. The study protocol was approved by the Ethics Committee of Kırşehir Ahi Evran University Faculty of Medicine.

Measures

Schedule for Affective Disorders and Schizophrenia for School Aged Children Present-Lifetime Version (K-SADS-PL) The psychiatric diagnoses were established by using Turkish version of K-SADS-PL. K-SADS, developed by Kaufman et al. and validity and reliability study conducted in 1997, is a semi-structured diagnostic interview designed to assess current and past episodes of psychopathology in children and adolescents, according to DSM-IV criteria.[20] The validity and reliability study in Turkey were carried out by Gökler et al. in 2004.[21]

Statistical analysis

The data were analyzed using the Statistical Package for Social Sciences-SPSS for IBM, 20.0. Since age and intraocular pressure values did not show a normal distribution (Kolmogorov-Smirnov), the difference between the two groups was assessed by the Mann-Whitney U test. For other parameters (gender distribution, use of eyeglasses, the refractive errors, and the presence of allergic conjunctivitis) Chi-square test was used to determine the difference between the groups. Statistical significance was accepted as $p<0.05$.

Results

64 children diagnosed with ADHD and 60 healthy controls were included in the study. The mean age was 10.03±1.95 in ADHD group and 10.07±2.17 in the control group. In the ADHD group, the rate of boys was 59.37% (n=38), while the rate of girls was 40.63% (n=26). 55% of the control group was boy (n=33) and 45% was girl (n=27). There was no significant difference in terms of age (z=-0.108, p=0.914) and gender (X^2=0.492, p=0.623) between two groups (Table 1). Patients with ADHD had comorbid diagnoses of oppositional defiant disorder (20.3%), anxiety disorders (23.4%) tic disorders (7.8%), depressive disorders (3.1%), and enuresis (1.5%). Of the children in the ADHD group, 54.6% had at least one comorbid diagnosis.

The rate of refractive errors was 18.75% and 6.66% in the ADHD group and the control group, respectively. There was a significant difference between groups in terms of the refractive errors (X^2=2.006, p=0.045). 10 of 12 children who needed glasses had myopia (83.3%), 1 had hypermetropia (8.3%) and 1 had astigmatism (8.3%). The rate of refractive errors was higher in boys (%26.31) compared to girls (%7.69) then ADHD patients were classified according to gender and this difference was close to significance (X^2=1.875, p=0.061) (Table 2).

Table 1 Ophthalmic examination findings

		ADHD group % (n)	Control group % (n)	X^2/z value	P Value
Refractive errors		18.75% (12)	6.66% (4)	2.006	0.045*
Use of Eyeglasses		66.6% (8)	75% (3)	-0.311	0.755
Presence of Allergic Conjunctivitis		62.5% (40)	28.33% (17)	3.815	0.001**
Gender	boy	59.37% (38)	55% (33)	0.492	0.623
	girl	40.63% (26)	45% (27)		
		mean±SD	mean±SD		
Age		10.03±1.95	10.07±2.17	-0.108	0.914
İntraocular pressure (mmHg)		14.57±1.57	15.15±2.23	-1.683	0.095

Note ADHD, attention deficit hyperactivity disorder, SD, standard deviation

*p<0.05

**p<0.01

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Table 2 Measurements for girls and boys

	Boys (n=38) %(n)	Girls (n=26) %(n)	z value	p Value
Refractive error	%26.31(10)	%7.69 (2)	1.875	0,061
Use of Eyeglasses	40% (4)	100% (2)	-1.549	0,121
Allergic Conjunctivitis	57.89% (22)	69.23% (18)	-0.92	0,358

When the use of eyeglasses was examined; the rate of wearing glasses in the control group was 75%, whereas it was 66.6% in the ADHD group. Although the need for eyeglasses, the rate of not wearing glasses was higher in ADHD patients compared to controls, but this difference was not statistically significant (X^2=-0.311, p=0.755). The rate of the presence of Allergic Conjunctivitis was 62.5% in ADHD group while 28.3% in the control group. Patients with ADHD had significantly higher rates of the presence of allergic conjunctivitis compared to controls (X^2=3.815, p= 0.001). When the groups were evaluated in terms of intraocular pressure; mean intraocular pressure was 14.57±1.57 mmHg in the ADHD group and 15.15±2.23 mmHg in the control group. There was no statistically significant difference between groups (z=-1.683, p=0.095) (table 1).

Discussion

In this study, we examined whether refractive errors, use of eyeglasses, presence of allergic conjunctivitis and intraocular pressure measurements differ between the children and adolescents with ADHD and the age-matched controls. According to the result of our study, there were significant differences in terms of refractive errors and the presence of allergic conjunctivitis between children and adolescent with ADHD and the controls. When ADHD patients have been grouped according to gender; it has been determined that refractive errors were almost statistically significantly higher in boys than girls. In a recent survey of 75171 children aged 4-17 years in the United States, the rate of ADHD diagnosis in children with and without vision problems as determined through parental interviews was investigated. It was found an increased prevalence rate of ADHD among children with vision problems (%15.6) compared to children with normal vision (%8.3). In a study of children with congenital cataracts aged 3-8 years, it was found that the patients were more likely to have ADHD symptoms reported by the family compared to controls.[22] In a cohort study of 6817 children, the risk of ADHD in patients with amblyopia was reported to be 1.81-fold.[17] In another study, it has been found that the incidence of ADHD was 3 times higher in patients with convergence insufficiency (CI), while the incidence of CI was 3 times higher in patients with ADHD.[15] Grönlund et al. found that patients with ADHD had a higher rate of ocular findings including structural optical changes compared to controls and they reported that the deficits did not improve with stimulant therapy.[23] Merdler et al. found no association between strabismus and psychiatric disorders in adolescents even after strabismus correction.[24] In a single study investigating refractive error in children with ADHD, no difference was found in terms of seeing the distance and near compared to the controls.[14] There are different results of studies investigating refractive errors in schizophrenia, psychiatric disorder other than ADHD. In a study examining the relationship between schizophrenia and myopia, it was not found any difference regarding frequency of myopia between schizophrenic patients and healthy controls.[25] In another study, in Israel with 17-year-old schizophrenia patients, has found an inverse relationship between refractive errors and schizophrenia.[5]

Another important finding in our study was that allergic conjunctivitis presented significantly more frequent in cases with ADHD than the controls. Previous studies have shown that the frequency of allergic rhinitis and atopy is higher in children with ADHD than in normal children.[26–28] It has been known that hypersecretion of immunoglobulin-E (IgE), increased eosinophilic activity and a predominantly T helper type 2 (TH2) cytokine secretion is associated with atopy. Although the relationship between atopy and the development of ADHD has not been fully elucidated, an increasing number of studies suggest that inflammatory cytokines released during the atopic response may pass the blood brain barrier and activate neuroimmune mechanisms that involve behaviorally and emotionally relevant circuits.[29–31]

The small sample size and cross-sectional design are the main limitations of our study Despite the limitations, it is important to note that the rate of non-use of glasses is high in male subjects despite the need for wearing glasses. Thus, the ADHD may be misdiagnosed in patients with refractive errors who do not wear glasses. Further studies need to be done to clarify whether ADHD symptoms develop secondary to visual problems or whether common genetic factors play a role in the development of both diseases. Studies that diagnostic evaluation is performed after correcting visual impairment and executive functions are evaluated with cognitive tests may also contribute to the answers to the questions of whether ADHD diagnostic criteria can be valid in children with visual impairment.

Conclusion

Our work highlighted that children and adolescents with ADHD had significantly higher rates of refractive errors compared to healthy controls. It is important that Child and Adolescent Psychiatrists treat ADHD, especially boys, with a multidisciplinary approach including routine eye examination the results of our study are also important in terms of shedding light on the studies to be done to clarify the immunological origin of ADHD.

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None.

Conflicts of interest

The authors declare that there is no conflict of interest.

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