Comparison of Visual Functions and Ocular Health in Children with Autism Spectrum Disorder and Typically Developing Peers

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ABSTRACT

Purpose: To compare the visual functions and ocular health between children with Autism Spectrum Disorder (ASD) and Typically Developing (TD) Peers.

Methodology: A comparative cross-sectional study was conducted after ethical approval vide no 1627/22. The sample size of 80 was gathered by convenient sampling. Two groups were made, each comprising of 40 individuals i.e. Group A having 40 children diagnosed with ASD and Group B having 40 typically developing children. Inclusion criteria for group A was children of either gender aging 6-16 years and diagnosed with ASD. Exclusion criteria for group A was children diagnosed with severe degree of ASD. Visual acuity was tested by Snellen chart, contrast sensitivity on Pelli-Robson, color vision by primary colors detection and visual field by handheld peripheral field perimeter. The statistical test was performed by using Mann Whitney test and Chi-square test (p value ≤ 0.05).

Results: Out of 40 children with ASD, 15(37.5%) had VA$\leq$ 0.5. 19(23.75%) had reduced contrast sensitivity. Three (3.75%) had some color vision defect. Out of 40 TD peers, 17(42.5%) had VA$\leq$ 0.5. 17(21.25%) had reduced contrast sensitivity. While checking ocular health of ASD group, only 20 had some ocular health problems in which 7(8.75%) had strabismus, 3(3.75%) had eye movement disorders, 2(2.50%) had hypertelorism and ptosis respectively. Similarly, in TD group, 16 had ocular problems in which 6(7.50%) had strabismus, 2(2.50%) had hypertelorism.

Conclusion: There was no significant difference in visual functions and ocular health of children who had ASD and TD Peers.

Key words: Visual Functions, Ocular Health, Autism Spectrum Disorder.

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INTRODUCTION

Autism spectrum disorder (ASD) impacts how a person socialize with others and include difficulty in communication and learning.[1] It is mainly caused by chromosomal abnormalities, gene mutations and exposure of offspring to viral or bacterial infection.[2] In recent years, ASD has shown an increase in prevalence. The American Academy of Pediatrics has reported a prevalence rate of 1 outof 91 children in

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the age group of 3–17 years.[3] In Pakistan, the prevalence of ASD maybe higher due to its association with learning disabilities which are prevalent here. There is an increased prevalence of ASD (2.57/1000), along with higher rates of hearing and vision problems.[4] ASD is more common in males than in females, with a ratio of 3:1.[5]

Individuals with autism have difficulty in processing sensory and visual information. Autistic children have difficulty in memorizing colors and differentiating between them. Visual problems have been considered as a prevalent impairing condition especially in children with congenital cerebral anomalies, with learning difficulty and with severe hearing impairment.[6] In a research conducted to compare visual symptoms of group of autistic individuals with age matched individuals, data showed 44% of children with ASD had higher incidence of refractive error.[7] In another research with sample of 34 autistic children, 50% had strabismus in which 65% had exotropia and 35% had esotropia.[8] In another study, ocular testability in ASD individuals versus typically developing (TD) peers was conducted. Tests with ASD were strongly related to their communication level. Hence, it was concluded that testability was high (TD 100%, ASD 88-100%).[9]

For children diagnosed with ASD, early intervention can have a positive impact on cognitive, social development of these individuals. Getting a diagnosis of ASD can be time-consuming for families of these children.[10] Like many other developing countries, autism is a neglected health issue in Pakistan. The children with ASD are generally lumped together with the other learning disabilities. [11] Though many studies have been conducted on autism, in Pakistan still is there is a lack of research to compare vision tests and ocular problems with typical peers. The purpose of this study is to screen children with ASD for any visual and ocular problems and compare it, so that we can manage it and provide referral as early as possible to reduce further complications.

METHODOLOGY

For this comparative cross sectional study, data was collected after approval from ethical review board of College of Ophthalmology & Allied Vision Sciences (COAVS), Lahore vide no 1627/22. Study was conducted at COAVS from March, 2022 till December, 2022. Sample size of 80 was calculated by taking 5% level of significance, 90% power of test, 89% proportion of ASD and 71% proportion of TD.[11]

The sample size of 80 was gathered by convenient sampling. Two groups were made, each comprising of 40 individuals i.e. Group A having 40 children diagnosed with ASD and Group B having 40 typically developing children. Inclusion criteria for group A was children of either gender aging 6-16 years and diagnosed with ASD. Inclusion criteria for group B was typically developing gender of either gender aging 6-16 years. Exclusion criteria for group A was children diagnosed with severe degree of ASD and children with any other co-existing pathology other than ASD. Children with ASD were sampled from autism centers and the typically developing peers were sampled from out-patient department.

Visual functions were assessed by testing visual acuity on Snellen chart, contrast sensitivity by Pelli-Robson (Smart Optometry App version 4.6), color vision by primary colors detection and visual field by handheld peripheral field perimeter. In ocular pathologies, strabismus was checked by Hirschberg test, eye movement disorders by checking extraocular motility, cataract by pen torch, nystagmus, hypertelorism and ptosis by ocular examination of individuals. Data was recorded on a self-designed proforma. Written consent was taken before the start of examination on the attached consent form. The statistical test was performed by using Mann Whitney test and Chi-square test. A p value ≤ 0.05 was taken as significant.

RESULTS

Data was stratified after entry on self-designed proforma and then Mann Whitney test was applied for data analysis. Out of 40 autistic individuals, 32 were male and 8 females. In 40 TD peers, 19 were male and 21 females. In ASD group, 15/40 had visual acuity $\geq$ 6/18 and in TD, 17/40 had visual acuity $\geq$ 6/18 in both eyes (Table 1). In ASD, 21

(26.25%) had normal and 19 (23.75%) had reduced contrast sensitivity (Table 2). In TD, 23 (28.75%) had normal while 17 (21.25%) had reduced contrast sensitivity. In ASD, 37(46.25%) had normal color vision and 3 (3.75%) had some defect while all TD peers had normal color vision (Table 3). Both groups had 38 (47.50%) individuals with normal visual field and 2 (2.50%) with reduced field (Table 4).

For ocular health, cross tabulation was applied. Out of total 40 individuals who had autism, 20 had some ocular health problems in which 7 (8.75%) had strabismus, 3 (3.75%) had eye movement disorders, 2 (2.50%) had hypertelorism and ptosis respectively and 1 (1.25%) had nystagmus. Similarly, in TD group, 16 had ocular problems in which 6 (7.50%) had strabismus, 2 (2.50%) had hypertelorism, 1 (1.25%) had ptosis and eye movement disorders respectively (Table 5). Data was entered and analyzed on SPSS software version 25. P value ≤ 0.05 was considered significant.

Table -1: Visual Acuity

		Group		
		ASD	TD	Total
VA_BE	.00	5	11	16
	.10	5	0	5
	.20	7	4	11
	.30	3	2	5
	.40	5	6	11
	.50	5	4	9
	.60	3	2	5
	.63	0	1	1
	.70	6	4	10
	.80	1	2	3
	.90	0	2	2
	1.00	0	2	2
Total		40	40	80

Table 1 shows binocular visual acuity of children with Autism Spectrum Disorder and Typically Developing Peers.

Table -2: Contrast Sensitivity

		Contrast_Sensitivity		
		Normal	Reduced	Total
Group	ASD	21	19	40
	TD	23	17	40
Total		44	36	80

Pearson Chi-Square Test was applied and resulting value was 0.653> 0.05. There was no significant difference between both groups.

Table -3: Color Vision

		Color Vision		
		Normal	Defective	Total
Group	ASD	37	3	40
	TD	40	0	40
Total		77	3	80

Fisher's Exact Test was applied and resulting value was 0.241> 0.05. There was no significant difference between both group**s.**

Table -4: Visual Field

		Visual_Field		
		Normal	Reduced	Total
Group	ASD	38	2	40
	TD	38	2	40
Total		76	4	80

Fisher's Exact Test was applied and resulting value was 1.00 > 0.05. There was no significant difference between both groups.

Table -5: Ocular health of patients (ASD vs TD)

		Group		Total
		ASD	TD	
Ocular health of patients		20	16	36
	Cataract	0	2	2
	Eye movement disorders	3	0	3
	Eye Movement Disorders	0	1	1
	Eye movement disorders, Hypertelorism	1	0	1
	Hypertelorism	2	2	4
	Nystagmus	1	0	1
	Ptosis	2	1	3
	Ptosis,Hypertelorism	1	0	1
	Strabismus	7	6	13
	Strabismus, Eye Movement Disorder	0	3	3
	Strabismus, Eye Movement Disorders	0	1	1
	Strabismus, Eye Movement Disorder	0	1	1
	Strabismus, Eye Movement Disorder	0	3	3
	Strabismus, Eye Movement Disorders	1	0	1
	Strabismus, Eye Movement Disorders	0	2	2
	Strabismus, Eye Movement Disorders, Nystagmus	0	1	1
	Strabismus, Eye Movement Disorders	0	1	1
	Strabismus,Hypertelorism	1	0	1
	Strabismus,Nystagmus	1	0	1
Total		40	40	80

Table 5 shows the distribution of ocular pathologies and their frequencies in both groups.

DISCUSSION

Our study on comparison of visual functions and ocular health between children with ASD and TD shows that both groups responded to in a much similar way to different tests that were performed. The results show that there was no significant difference between both groups. Autistic individuals had some difficulty in naming the colors so color vision was assessed by asking them to point certain colors. Only 3 (3.75%) autistic individuals had some defects in color vision. Only 2 (2.50%) had reduced field in both groups. Twenty ASD individuals while 24 TD children had some ocular problems majorly strabismus, eye movement disorders, hypertelorism, ptosis, nystagmus and cataract.

Previous studies reported that there was no difference between visual acuity of individuals with ASD and without ASD when checked by Landolt-C chart. Vision was taken with spectacles and best corrected visual acuity was assessed. There was no difference between the best corrected visual acuity of individuals with ASD (-0.15 log mar) and controls (-0.18 log mar).[12] For children with autism, identification of any target among others require some discrimination that can be based on color. In another research to compare color target search in ASD and TD, it was concluded that TD acquired position closest to visual target than ASD. Moreover, time to reach target was shorter for ASD than for TD.[13]

It was reported that 10 individuals with ASD show poor performance on when lighting conditions were less i.e in low contrast and 4 children showed poor performance on edge contrast sensitivity. There were no differences in static contrast responses between both groups.[14] A previous study was conducted to compare left visual field bias in both groups. Typically developing controls preferred to look on left side of face so they showed left visual field bias. It was due to faster brain processing in discriminating gender. On the other hand, autistic individuals didn't show left visual field bias but they preferred to look on eye region of face than the mouth region.[15]

According to a previous study conducted in 2020, the prevalence of strabismus in ASD is 13.4% and it was 3-10 times more as compared to general population. The prevalence of nystagmus in ASD was 1.6%. Ptosis was present in 40% of children who have attention deficit hyperactivity disorder (ADHD) and autism spectrum disorder (ASD).[16] Orbital hypertelorism is a common presenting sign of autism that is related to severity of ASD. In another study to compare orbital region of both groups, it was concluded that there was a significant difference between male members and all of them had higher orbital region distances as compared to females.[17]

Another study with sample size of 120 ASD children showed that 20.6% had refractive errors (including myopia and hyperopia) and 56.7% had strabismus. The increased prevalence of refractive errors and strabismus showed that special students have higher ocular morbidity. More than half students with ASD had at least one ocular morbidity, the commonest being refractive errors followed by strabismus.[18] With such high rates of ocular problems among ASD, initial comprehensive assessment of all students

diagnosed with ASD is recommended. Assessment should be followed by action oriented remedial or care system to monitor the improvement and progress in quality of life of the child.[19]

The treatment for ASD include symptomatic interventions which play a significant role in dealing and handling individuals. For this, medication and therapies can be used including Behavioral therapy and speech therapy.[20] Strengths of this study include a comparative cross-sectional study design, a study population drawn from community, specific age group range for both groups and detailed assessment of each visual function. Our findings about visual functions of individuals with autism and typically developing peers can have potential research and clinical implications in future. This data can be used to assess differences about visual acuity, color vision, contrast sensitivity and visual field in both groups in a specific age range. Our study can be used to provide rationale for early assessment, diagnosis and treatment of different conditions in these individuals. Limitation of this study is collection of sample from single autism centre. Awareness regarding autism and its related disorders should be increased among parents and healthcare providers so that it can be diagnosed and managed as early as possible. Authors declare no conflict of interest in reporting this research.

CONCLUSION

There is no significant difference between visual functions and ocular health of both groups. The frequency of all ocular pathologies was same in ASD and TD individuals except for nystagmus and cataract that is present more in children with autism spectrum disorder.

Conflict of Interest: None to declare

Ethical Approval: The study was approved by the Institutional Review Baord / Ethical Review Board No. 1637/23

Author Contributions: Aimon Iftikhar: Concept, Design, Data Collection, Drafting

Muhammad Shaheer: Data Collection & Analysis, Critical Review

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