

Children with Disabilities/Special Health Needs and Ocular Refractive Disorders

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ABSTRACT

Children with special needs face many eye problems that should be promptly addressed. Many eye diseases can be treatable if discovered in infancy. There is data showing these children have a higher prevalence of refractive errors than their non-disabled peers. If diagnosed and treated promptly, refractive errors can provide a good quality of life for special needs children.

Keywords: special needs children, refractive errors, Down syndrome, autism, deafness.

OBJECTIVE

Global reporting shows that around 15% of the world population or over one billion people have some kind of disability, be it physical, mental or intellectual (1).

The World Report on Disability (WRD) was launched at the UN headquarters in New York on the 9th of June 2011. The document reports that disability is the sum of obstacles encountered by a person with a condition as they interact with their environment (2) and also points out that medical recovery/rehabilitation allows

individuals with disabilities access to education, work and the civic market (2).

On the 31st of March 2020, the National Authority for Disabled People reported a total of 852,565 individuals with disabilities, representing 3.85% of Romania's population (3). According to Law no. 448/2006 aiming to protect and promote the rights of people with disabilities, there are different types of disability such as physical, visual, auditory, somatic, mental, psychological, HIV/AIDS, deafblindness, rare diseases. On the 31st of March 2020 there were 68,447 children registered as being disabled in some way, with 1,296 of them being from

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Bihar county, all non-institutionalized, *i.e.* with families (3).

Children with special needs need assistance in handling their medical, mental or psychological disabilities. Several researchers have shown that these vulnerable children have difficulties accessing eye care services or that the information disseminated among them has not been fully understood. There are many types of special needs which vary in severity, including autism, Down syndrome, dyslexia, blindness, ADHD, cerebral palsy, mental retardation, and motor disabilities. The statistics reveal that 15% of children aged 3 to 17 have special needs. There is a high prevalence of disabilities in developed countries. The visual dysfunction integrates all senses and it is not at all surprising that a severe visual dysfunction will restrict the development of all the other senses (4).

The history of disability

All societies hold the ancient belief that disabled people are less human and therefore, not eligible to enjoy the opportunities available to the non-disabled persons (4).

Throughout the times, disabled people received different treatments compared to their “normal” peers and we shall list some examples here:

- abandoned or killed;
- the early history of the United States noted that people suffering from disabilities were homeschooled so as not to be exposed to society;
- in Nazi Germany they were gassed, drugged or exsanguinated;
- they suffered from abuses of all sorts throughout the whole history.

Presidents Harry Truman, John F. Kennedy, Ronald Reagan, George Bush and Bill Clinton advocated a lot for establishing education for persons with disabilities (4, 5).

Over the last decades, the increased visibility of people with disabilities was felt as a normality of everyday life, as they were fully accepted by school personnel, community or their peer students. How one relates to those around them is dependent upon, not only, their individual level of comfort, previous experiences, feelings, cognitive level, social skills. The success or failure of persons with disability is influenced by their relationship with those around them (5).

Children with special health needs and eye problems

International studies show that pediatric patients diagnosed with special needs have refractive errors and various ocular disorders, but their prevalence is still not well defined, although some studies show that they are much more prone to them (6). It is a well known fact that these children often have multiple deficiencies; thus, The Hall recommends that a visual screening is performed on 4-5 years old children, especially for those with neurological deficiencies (7). Strabism and refractive errors occur with a frequency of at least 10% among children with disabilities versus 0.15% in generic pediatric population, many of which being treatable. A good proportion of the socio-academic activities of these children have their basis on children’s visual skills, so that early and prompt detection of an eye problem, even a minor one, is extremely important for them (8).

In 2006, Nielsen *et al.* conducted a study on a group of 1126 children with disabilities from Copenhagen, and the prevalence of the identified visual deficit secondary to refractive errors was 10,5% (9). The diagnosed developmental issues in these children were cerebral palsy, epilepsy, deafness and autism. Another study was conducted in Oman on children with special health needs and a control group confirmed that refractive errors occurred in 58.5% of subjects in the first group and in 2.9% of controls who were clinically healthy children (10).

Down syndrome

As confirmed by many researchers, Down syndrome is one of the most frequent genetic anomalies, and children suffering from this disease have an increased risk of developing eye conditions such as refractive errors, strabismus, blepharitis, nasolacrimal duct problems, cataracts or keratoconus (11, 12). The anomaly was first described in 1866 by Langdon Down. It is a pathology in which the affected person has 47 chromosomes rather than 46, being present in all races, all nationalities and any kind of socioeconomic condition. The extra genetic material found in Down syndrome produces a disruption in the normal developmental process, resulting in various intellectual, medical and physical anomalies such as short stature, Mongolian eyes,

heart problems, skeletal abnormalities, obesity, eye-visual abnormalities, refractive problems, ocular abnormalities of the anterior pole and the posterior pole (13).

Visual acuity maturation occurs much slower within this group of children, many of them with low visual acuity, even if the refractive values are well corrected (14). Usually, these people age faster, so they are diagnosed with early eye problems, but also age-related systemic conditions such as cognitive problems.

Research conducted on them reveals that they need special eye care (15). The incidence of ocular abnormalities in children with Down syndrome varies by study, the prevalence of eye changes and problems at ocular level is between 3-63% of cases (16). Down syndrome patients are usually communicative, so it is rather easy to interact with them, thus making the eye consultation also easy. According to Akinci's studies astigmatism has an occurrence of 60% in Down syndrome patients and 25% in the control group and nystagmus at a rate of 22% (16). Most of the times, given the intellectual challenges, eye conditions are ignored. The problem also resides in the fact they do not complain or cannot express themselves very well. Based on studies, strabismus is often found in children with Down syndrome regardless of the refractive error, with a prevalence of approximately 42%. Visual acuity and contrast sensitivity are often deficient in children with Down syndrome, even if refractive problems or eye conditions are not present, and are not attributed to the low compliance of children at the time of testing (17).

Deafness

Hearing disorders are one of the most important health problems that profoundly affect the quality of life and have been reported to have a prevalence of 1.4% among children aged 5-14 years (18). The association of visual and hearing disorders has a profound negative impact on the cognitive and communication abilities, especially in childhood, because sight is very important as a form of interaction for those suffering from deafness.

Deaf-mute people use visual-perceptual cues to communicate, so an ophthalmologic screening performed among them is of crucial importance to maximise the social and cognitive

skills (19). Research conducted on hearing-impaired and deaf-mute population show that the prevalence of eye conditions such as refractive errors is 35-57% (20). The prevalence of amblyopia and strabismus is 12.2% and 3% of cases, respectively. Among the refractive errors, hyperopia is the most common, hearing-impaired children being five times more likely to have this refractive error (21).

There are also studies that showed no difference in the prevalence of hyperopia and myopia, while a few others reporting that myopia was the more prevalent condition (22). Most of studies conducted on these children are descriptive and did not include a control group. An eyeball with a hyperopia type of refractive error has a short axial length, which is considered an immaturity phenomenon. Given that a hearing impairment, especially of congenital nature, can be associated with immaturity of the neural tissues, the immaturity of the axial length of the eyeball produces refractive disorders of the hyperopic type. Since hyperopia is common in this group, amblyopia is also frequently diagnosed (22, 23).

Autism spectrum disorders (ASD)

In the 1970s, a number of international publications stated that there were links between the development of autistic behavior in visually impaired children, secondary to low-intensity motor stimulation due to lack of light (24, 25). Leo Kanner was the first doctor to hypothesise the existence of an autistic disorder (26). This disorder does not have a clear etiology, but environmental, genetic and embryological factors are held responsible. It is more common in males and the IQ level can vary from retardation to superior levels for people diagnosed with this disorder (27). Autism spectrum disorder (ASD) is a neurological disorder characterized by difficult social behaviour, difficulties in verbal and non-verbal communication, hyperactivity, patterns of repetitive behaviour with little and insignificant activity lasting for at least six months (28). It was first listed in DSM-3 in 1980 (29).

In the recent years, progress has been made in regard to decrypting neuroimaging in those diagnosed with ADHD, so findings reveal a decrease in the volume of the prefrontal cortex, basal ganglia, corpus callosum and cerebellum (30, 31). People affected by autism show signs of

the disorder in the first three years of life; they establish little eye contact, are almost devoid of facial expression, and have relational difficulties. Contrary to these signs and symptoms, ADHD persons often have superior visual sensitivity (32).

The eye conditions that can appear in these children include nystagmus, strabismus, and refractive problems (33). Some people are born with prosopagnosia, meaning they will never be able to recognize faces, which will make their communication with others unusual. These children are not to be diagnosed with autism, even though they will not gaze at the faces of those around them (34).

Various studies have emphasized that visual dysfunctions were more common among these children. The visual dysfunction often goes undiagnosed because the signs are difficult to spot. The first European study on the matter was conducted by Pamela *et al.* on a group of 128 children with autism spectrum disorders and revealed a rather high prevalence of astigmatism (26%) (35). Findings from various studies report that nystagmus, as well as strabismus, is common in these children. O'Donoghue shows a 22-33% prevalence of refractive errors in this group, which is statistically irrelevant compared to 29-32% of the general pediatric population (36). The prevalence of strabismus in children diagnosed with a disorder in the autistic spectrum varies from 1.5%, according to Xiao *et al.*, to 8.3% in studies performed by O'Donoghue and Friedman *et al.* (36-38).

The prevalence of refractive errors varies from 22% to 33%, according to Kabatas *et al.* studies (39). Baron-Cohen *et al.* explored the presence of autism spectrum manifestations in a pediatric group suffering from blindness and found a prevalence of 11.6% (40).

It is highly important that a child suspected of having an autism spectrum disorder receives an ophthalmological examination as well in order to diagnose and treat a possible eye condition, and it does not interfere with the child's optimal development (41). The proper functioning of the visual analyzer for children diagnosed with this disorder is supportive and must be recognized, and such patients should not be regarded as suffering from an autistic disorder based on the concurrent presence of an eye condition.

The visual dysfunction may interfere with the abilities of the pediatric patient, so the parents

and the multidisciplinary team who are in charge with the child's daily care must be informed on the possibility of an eye condition and treatment, when the case (41).

Attention-deficit/hyperactivity disorder (ADHD)

Attention-deficit/hyperactivity disorder (ADHD) is one of the common psychiatric disorders diagnosed in children, with a global prevalence of 5.3% (42).

Attention-deficit/hyperactivity disorder is characterised by attention deficit, hyperactivity, impulsiveness and inadequate behaviour (43). Despite variations in study results on the connection between visual dysfunction and school performance, it is believed that there is a relation between visual symptoms and behavioural problems manifesting with ADHD (44, 45).

A number of studies show that pediatric patients diagnosed with ADHD have an increased prevalence of eye conditions, color perception deficiency, but not higher than the control groups (46-48). Ametropia and reduced stereo acuity are the most common eye conditions in children with ADHD (49, 50). The hyperactivity of these children might be connected to the presence of an undiagnosed hyperopia, which is more prevalent than in the control groups, where myopia is the more common (51-54).

It is beneficial for children with eye problems to be examined for signs and symptoms of ADHD, but also the other way around (55). The risk of ADHD is higher in children with amblyopia (56).

CONCLUSIONS

Down syndrome, ADHD, deafness and autism can be associated with various eye conditions. Many of eye diseases associated to a disability such as refractive errors are treatable, and children suffering from any of these disabilities must have an ophthalmological assessment as soon as possible in order to maximize all their abilities and facilitate their educational route.

As they all depend on adults and society next to them, an ophthalmological screening is extremely useful for all children suffering from a disability, so that the future adult could have a harmonious life. This review points out that children with disabilities should be early referred to ophthalmologists for further investigations and

treatment when necessary, because they all pose a higher risk of developing refractive errors. □

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REFERENCES

- World Health Organization.** International Classification of Functioning, Disability and Health (ICF). Switzerland: Geneva, 2001. URL: www3.who.int/icf/icftemplate.cfm.
- World Health Organisation,** World Bank. World Report on Disability. Geneva. WHO, 2011, page 198.
- http://anpd.gov.ro/web/wp-content/uploads/2020/07/BULETIN-STATISTIC-ANDPDCA_adulti-TRIM-I-2020-13-07-20.pdf
- <https://www.nytimes.com/2002/06/24/us/justin-dart-jr-71-advocate-for-rights-of-disabled-people.html>
- https://uk.sagepub.com/sites/default/files/upm-binaries/26491_Chapter_1_Historical_Background_of_Disabilities.pdf
- Das M, Spowart K, Crossley S, et al.** Evidence that children with special needs all require visual assessment. *Arch Dis Child* 2010;95:888-892.
- Hall D, Elliman D.** *Health for all children.* Revised 4th ed, Oxford: Oxford University Press, 2008.
- Puri S, Bhattarai D, Adhikari P, et al.** Burden of ocular and visual disorders among pupils in special schools in Nepal. *Arch Dis Child* 2015;9:834-837.
- Nielsen LS, Skov L, Jensen H.** Visual dysfunctions and ocular disorders in children with developmental delay. I. Prevalence, diagnoses and aetiology of visual impairment. *Acta Ophthalmol Scand* 2007;85:149-156.
- Urmi Vora, Rajiv Khandekar, Sarvanan Natrajan, et al.** Refractive Error and Visual Functions in Children with Special Needs Compared with the First Grade School Students in Oman. *Middle East Afr J Ophthalmol* 2010;4:297-302.
- Cavezian C, Vilayphonh M, Vasseur V, et al.** Ophthalmic disorder may affect visuo-attentional performance in childhood. *Child Neuropsychol* 2013;19:292-312.
- Liyanage S, Barnes J.** The eye and Down's syndrome. *Br J Hosp Med.* 2008;69:632-643.
- Woodhouse JM, Pakeman VH, Saunders KJ, et al.** Visual acuity and accommodation in infants and young children with Down's syndrome. *J Intellect Disabil Res* 1996;40:49-55.
- Block SS, Beckerman SA, Berman PE.** Vision profile of the athletes of the 1995 Special Olympics World Summer Games. *J Am Optom Assoc* 1997;68:699-708.
- Kim JH, Hwang JM, Kim HJ, et al.** Characteristic ocular findings in Asian children with Down syndrome. *Eye (Lond)* 2002;6:710-714
- Akinci A, Oner O, Bozkurt O H, et al.** Refractive errors and strabismus in children with Down syndrome: a controlled study. *Journal of Pediatric Ophthalmology and Strabismus* 2009;2:83-86.
- Kim JH, Hwang J-M, Kim HJ, et al.** Characteristic ocular findings in Asian children with Down syndrome. *Eye* 2002;16:710-714.
- Stevens G, Flaxman S, Brunskill E, et al.** Global Burden of Disease Hearing Loss Expert G Global and regional hearing impairment prevalence: an analysis of 42 studies in 29 countries. *Eur J Public Health* 2013;23:146-152.
- Woodruff ME.** Differential effects of various causes of deafness on the eyes, refractive errors, and vision of children. *Am J Optom Physiol Opt* 1986;8:668-675.
- Regenbogen L, Godel VJ.** Ocular deficiencies in deaf children. *Pediatr Ophthalmol Strabismus* 1985;6:231-233.
- Cruickshanks KJ, Dhar S, Dinces E.** Hearing impairment prevalence and associated risk factors in the hispanic community health study/study of Latinos. *JAMA Otolaryngol Head Neck Surg* 2015;141:641-648.
- Florina S, Corina L, Marie-Jeanne K, et al.** Refractive and Visual Outcome after Laser-Treated Retinopathy of Prematurity in Western Romania. *Maedica J Clin Med* 2016;6:122-129.
- Fraiberg S.** *Insights from the Blind: Developmental Studies of Blind Children.* Basic Books, New York, NY, USA, 1977.
- Trachtman JN.** Background and history of autism in relation to vision care. *Optometry* 2008;7:391-396.
- Mocanu V, Horhat R.** Prevalence and Risk Factors of Amblyopia among Refractive Errors in an Eastern European Population. *Medicina* 2018;1:6.
- Autism Spectrum Disorders.** Key Facts. <https://www.who.int/news-room/fact-sheets/detail/autism-spectrum-disorders>, Published in April 2017.
- Autism Speaks.** *What is autism?* Available from: <http://www.autismspeaks.org/what-autism>.
- Brown AC, Crewther DP.** Autistic Children Show a Surprising Relationship between Global Visual Perception, Non-Verbal Intelligence and Visual Parvocellular Function, Not Seen in Typically Developing Children. *Front Hum Neurosci* 2017;11:239.
- American Psychiatric Association.** *Diagnostic and Statistical Manual of Mental Disorders.* 3 (DSM-III) Washington: American Psychiatric Association, 1980.
- Arnsten AFT, Berridge CW, McCracken JT.** The neurobio-logical basis of attention-deficit/hyperactivity disorder. *Prim Psychiatry* 2009;15:53-59.
- Holhos LB, Coroi MC, Holt G, et al.** The Burden of Assessing Ocular Status of Children - Causes and Control. *Maedica (Bucur)* 2020;3:391-393.
- Shah A, Frith U.** An islet of ability in autistic children: a research note. *J Child Psychol Psychiatry* 1983;24:613-620.
- Baxter AJ, Brughra TS, Erskine HE, et al.** The epidemiology and global burden of autism spectrum disorders. *Psychol Med* 2015;3:601-613.
- Corrow SL, Dalrymple KA, Barton JJ.** Prosopagnosia: current perspectives. *Eye Brain* 2016;8:165-175.
- Pamela A, Kathryn S, Stephen G, et al.** *Investigative Ophthalmology & Visual Science* June 2013;15:569.
- O'Donoghue L, McClelland JF, Logan NS, et al.** Refractive error and visual impairment in school children in Northern Ireland. *Journal of Ophthalmology* 2010;94:115-1159.
- Xiao O, Morgan IG, Ellweing LB, et al.** Prevalence of amblyopia in school-aged

- children and variations by age, gender, and ethnicity in a multi-country refractive error study. *Ophthalmology* 2015;9:1924-1931.
38. **Friedman DS, Repka MX, Katz J, et al.** Prevalence of amblyopia and strabismus in white and African American children aged 6 through 71 months: the Baltimore Pediatric Eye Disease Study. *Ophthalmology* 2009;11:2128-2134.
 39. **Kabatas EU, Ozer PA, Ertugrul GT, et al.** Initial ophthalmic findings in Turkish children with autism spectrum disorder. *Journal of Autism and Developmental Disorder* 2015;8:2578-2581.
 40. **Baron-Cohen S, Scott FJ, Allison C, et al.** Prevalence of autism-spectrum conditions: UK school-based population study. *The British Journal of Psychiatry* 2009;6:500-509.
 41. **Kelsey B, Cheryl McC, Mary L, et al.** Ocular Manifestations of Autism in Ophthalmology. *Strabismus* 2013;298-102.
 42. **Polanczyk G, Jensen P.** Epidemiologic considerations in attention deficit hyperactivity disorder: a review and update. *Child Adolesc Psychiatr Clin N Am* 2008;17:245-260.
 43. **American Psychiatric Association.** *Diagnostic criteria from DSM-IV.* Washington: American Psychiatric Association, 1994, page 358.
 44. **Mezer E, Wygnanski-Jaffe T.** Do children and adolescents with attention deficit hyperactivity disorder have ocular abnormalities? *Eur J Ophthalmol* 2012;22:931-935.
 45. **Weiss MD, Gadow K, Wasdell MB.** Effectiveness outcomes in attention deficit/hyperactivity disorder. *J Clin Psychiatry* 2006;67:38-45.
 46. **Borsting E, Rouse M, Chu R.** Measuring ADHD behaviors in children with symptomatic accommodative dysfunction or convergence insufficiency: a preliminary study. *Optometry* 2005;76:588-592.
 47. **Kafali HY, Biler ED, Palamar M, Ozbaran B.** Ocular injuries, attention deficit and hyperactivity disorder, and maternal anxiety/depression levels: Is there a link? *Chin J Traumatol* 2020;2:71-77.
 48. **Silva AP, Frère AF.** Virtual environment to quantify the influence of colour stimuli on the performance of tasks requiring attention. *Biomed Eng Online* 2011;10:74.
 49. **Redondo B, Vera J, Molina R, et al.** Attention-deficit/hyperactivity disorder children exhibit an impaired accommodative response. *Graefes Arch Clin Exp Ophthalmol* 2018;256:1023-1030.
 50. **Fabian ID, Kinori M, Anciri O, et al.** The possible association of attention deficit hyperactivity disorder with undiagnosed refractive errors. *JAAPOS* 2013;17:507-511.
 51. **Bilbao C, Piñero DP.** Distribution of Visual and Oculomotor Alterations in a Clinical Population of Children with and without Neurodevelopmental Disorders. *Brain Sci.* 2021 Mar 10;11(3):351.
 52. **Gronlund MA, Aring E, Landgren M, et al.** Visual function and ocular features in children and adolescents with attention deficit hyperactivity disorder, with and without treatment with stimulants. *Eye (Lond)* 2007;21:494-502.
 53. **Kodak G, Duranoglu Y.** Amblyopia and Treatment. *Turk J Ophthalmol* 2014;44:228-236.
 54. **Dusek W, Pierscionek BK, McClelland JF.** Survey of visual function in an Austrian population of school-age children with reading and writing difficulties. *BMC Ophthalmol* 2010;10:16.
 55. **Bae S, Kim JT, Han JM, Han DH.** Pilot Study: An Ocular Biomarker for Diagnosis of Attention Deficit Hyperactivity Disorder. *Psychiatry Investig* 2019;5:370-378.
 56. **Karaca I, Demirkılınc Biler E, Palamar M, et al.** Stereoacuity, Fusional Vergence Amplitudes, and Refractive Errors Prior to Treatment in Patients with Attention-Deficit Hyperactivity Disorder. *Turk J Ophthalmol* 2020;1:15-19.