

Research Article

# Common Visual Impairments and Ocular Disorders in Children with Neurodevelopmental Disabilities

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## Abstract

**Background:** Visual impairments and ocular disorders are common but frequently overlooked complications in children with neurodevelopmental disabilities. Early identification and intervention are crucial for optimizing developmental outcomes in this vulnerable population. **Objective:** To investigate the prevalence and patterns of oculo-visual abnormalities in children with neurodevelopmental disorders attending the Child Development Centre at the Institute of Child and Mother Health (ICMH), Dhaka, Bangladesh. **Methods:** A cross-sectional study was conducted from September 2023 to February 2024, involving 64 children aged 0-18 years with neurodevelopmental disorders. Participants underwent ophthalmological examinations at three centers in Dhaka: The Child Development Centre (ICMH), Bangladesh Eye Hospital, and Children's Eye and Orthoptic Centre. Data were analyzed using SPSS version 21. **Results:** The study population comprised predominantly males (73.4%), with 35.9% aged  $\leq 1$  year. Urban residents (73.4%) had better access to early intervention services compared to rural populations. Strabismus (37.5%) and refractive errors (35.9%) were the most prevalent ocular disorders, followed by nystagmus (14.1%). Developmental delays (28.1%) and epilepsy/seizure disorders (18.8%) were the commonest neurodevelopmental conditions. A significant proportion (42.2%) presented with multiple ocular conditions. Children with Down syndrome showed the highest prevalence of visual impairments (71.4%). Corrective glasses were the primary intervention (39.1%), followed by medical treatment (18.8%). **Conclusion:** The present study found a high prevalence of visual impairments in children with different neurodevelopmental disorders, emphasizing the need for systematic condition-specific screening protocols and early intervention. This study also highlighted the importance of integrated care approaches and improved access to specialized eye care services, particularly in rural areas for greater success.

## Keywords

Visual Impairment, Neurodevelopmental Disorders, Pediatric Ophthalmology, Ocular Disorders, Developmental Delay

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## 1. Introduction

Visual impairments and ocular disorders represent significant problems in children with neurodevelopmental disabilities, often compounding their existing challenges with growth and development and affecting their overall quality of life. Visual issues are particularly concerning as they can significantly impact a child's ability to learn, communicate, and interact with their environment to develop the essential life skills. Despite their prevalence, visual impairments in this vulnerable population often remain underdiagnosed and undertreated, as healthcare providers and caregivers may prioritize other aspects of these children's condition.

Children with neurodevelopmental disorders face unique challenges in accessing regular optometry assessments, partly due to communication difficulties, behavioral problems, or inability to participate in standard vision screening procedures [1]. Research indicates that the prevalence of visual impairments in children with neurodevelopmental disabilities is significantly higher compared to the general pediatric population, with estimates suggesting that up to 15-40% of these children may have some form of visual dysfunction [2, 3].

The spectrum of visual problems in this population is diverse, ranging from refractive errors and strabismus to more complex conditions such as cortical visual impairment and optic nerve abnormalities [4]. Early identification and intervention are crucial, as visual impairments can have cascading effects on various developmental domains, including motor skills, social interaction, and cognitive development. However, the complexity of neurodevelopmental disorders often puts the visual symptoms behind, making the need for visual assessment and systematic screening particularly less important to the parents.

In Bangladesh, a low-income country with limited healthcare resources, the task of identifying and managing visual impairments in children with neurodevelopmental disabilities becomes even more troublesome. This study aimed to investigate the common oculo-visual abnormalities in children with neurodevelopmental disorders attending the Child Development Centre at the Institute of Child and Mother Health (ICMH).

## 2. Objectives

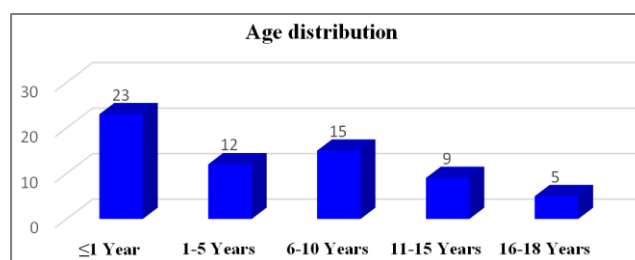
The primary objective of this study was to identify and characterize the common oculo-visual abnormalities present in children with neurodevelopmental disorders who attended the Child Development Centre at the Institute of Child and Mother Health (ICMH), Dhaka, Bangladesh. Additionally, we aimed to find out the prevalence of visual impairments and ocular disorders in this population and evaluate patterns of visual dysfunction across different neurodevelopmental conditions.

## 3. Materials and Methods

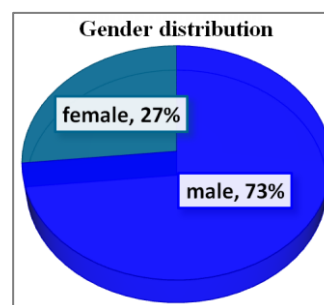
This cross-sectional study was conducted from September 2023 to February 2024, at three specialized centers in Dhaka, Bangladesh: The Child Development Centre at the Institute of Child and Mother Health (ICMH), Bangladesh Eye Hospital, and Children's Eye and Orthoptic Centre. The study protocol was approved by the institutional ethics review board, and informed consent was obtained from all. A total of 64 children aged 0-18 years, with confirmed neurodevelopmental disorders including Cerebral palsy, Autism spectrum disorder (ASD), Attention Deficit Hyperactivity Disorder (ADHD), Down's syndrome, Epilepsy, Global developmental delay, or other neurological conditions, were included in the study. Children with acute illnesses or those unable to complete the required examinations were excluded from the study. Demographic data were collected using a structured questionnaire, then each child underwent a comprehensive ophthalmological examination performed by experienced pediatric ophthalmologists. Data analysis was performed using Statistical Package for the Social Sciences (SPSS) version 21 for Windows. Data were presented with frequency (N) and percentage (%) values with appropriate tables and figures.

## 4. Results

This cross-sectional study involved 64 children having neurodevelopmental disabilities, aged between 0-18 years. The majority (35.9%) were aged  $\leq 1$  year, followed by 6-10 years (23.4%), and 1-5 years (18.7%). Male participants predominated (73.4%) over females (26.6%).



**Figure 1.** Bar graph showing the age distribution of study participants ( $n=64$ ).



**Figure 2.** Pie chart showing the gender distribution.

**Table 1.** Socio-demographic characteristics of study participants (N=64).

Characteristics	N	%
Religion		
Muslim	61	95.3
Non-muslim	03	4.7
Residence		
Urban	47	73.4
Rural	12	18.7
Semi-urban	5	7.8
Average Income		
Low income group	39	60.9
High income group	25	39.1
Consanguinity		
Yes	16	25
No	48	75
H/o eye problem in 1 <sup>o</sup> relatives		
Yes	22	34.8
No	42	65.2
Primary caregiver		
Mother	53	82.8
Other	11	17.2

\*Low income group = ≤50,000 Taka/month, High income group = ≥50,000 Taka/month

The socio-demographic characteristics (Table 1) revealed that most participants were from Muslim families (95.3%), and 73.4% resided in urban areas. The predominant (60.9%) income category was ≤50,000 Taka/month. A notable proportion (25%) had consanguineous parents, and H/o eye

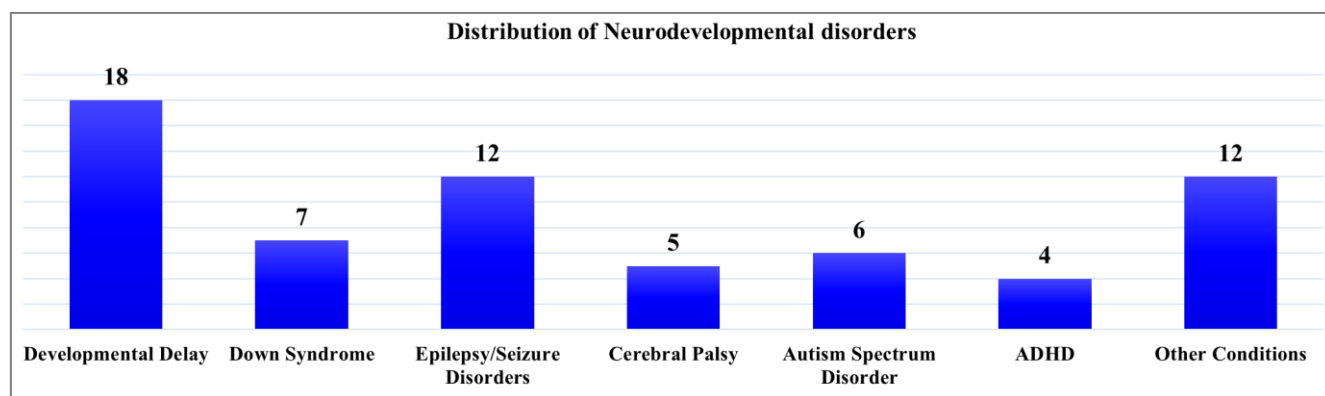
problems in 1<sup>o</sup> relative were found in about 35% of children. Primary caregiving was mostly assumed by mothers (82.8%).

Visual impairment patterns analysis revealed that 42.2% of participants had multiple ocular conditions, with the most common combination being refractive errors (35.9%) and strabismus (37.5%). Children with Down syndrome showed a higher prevalence of visual impairments (71.4%) compared to other neurodevelopmental conditions. Other ocular conditions included microspherokia, leukocorrhea or vitreous opacity, ophthalmoplegia, etc.

**Table 2.** Common visual impairments and ocular disorders in participants with neurodevelopmental disabilities (N=64).

Ocular Conditions	N	%
Refractive Errors	23	35.9
Strabismus	24	37.5
Nystagmus	9	14.1
Cataract	4	6.3
Optic Nerve Dysplasia	2	3.1
Retinal detachment and Vascular Anomaly	2	3.1
Amblyopia	1	1.6
Other Ocular Conditions	7	10.9

We found Neurodevelopmental disorders were involved with several syndromic conditions (i.e., Marfan syndrome, Joubert syndrome, Jacobsen syndrome, Stickler syndrome, Wiscott-Aldrich syndrome), as well as infectious or systemic diseases (Tubercular meningitis, steroid toxicity in Nephrotic syndrome) and structural abnormalities (Dandy-Walker syndrome, Agenesis of Corpus callosum, Coat's disease, Arachnoid cyst, and Schizencephaly). The study identified various neurodevelopmental conditions with the following distribution:

**Figure 3.** Distribution of participants by Neurodevelopmental disorders.

Various management strategies were implemented based on individual needs. The predominance of corrective glasses (39.1%) as the primary intervention strategy reflects current best practices, followed by medical treatment and only 'wait and observe' strategies (18.8% each). Visual stimulation was advised to the patients the least (4.7%).

**Table 3.** Distribution of children by management approaches (N=64).

Management Strategy	N	%
Corrective Glasses	25	39.1
Eye Patching	8	12.5
Surgical Intervention	4	6.3
Vision Stimulation	3	4.7
Medical Treatment	12	18.8
Wait and Observation Only	12	18.8

## 5. Key Findings

1. Urban residents had better access to early intervention services compared to rural populations.
2. Strabismus (37.5%) and refractive errors (35.9%) were the most common ocular disorders.
3. Developmental delay (28.1%) and epilepsy/seizure disorders (18.8%) were the predominant neurodevelopmental conditions.
4. Most patients (39.1%) required corrective glasses as the primary management approach.

## 6. Discussion

Our study provides important insights into visual impairments and ocular disorder patterns among children with neurodevelopmental disabilities in Bangladesh. The findings reveal several significant patterns that both align with and differ from previous research in this field.

The predominance of male participants (73.4%) in our study aligns with findings by Johnson et al. (2021), who reported a similar gender distribution (70.3% male) in their study of visual impairments in neurodevelopmental disorders [5]. The high proportion of patients aged  $\leq 1$  year (35.9%) suggests increasing awareness and early referral patterns, supporting Richards' (2022) emphasis on early intervention in neurodevelopmental care [6].

The urban predominance (73.4%) in our study population highlights potential healthcare access disparities, a concern similarly noted by Rahman's (2023) study of healthcare accessibility in Bangladesh [7]. This urban-rural divide in spe-

cialized healthcare access remains a significant challenge in developing countries, as documented by World Health Organization (WHO) reports [8].

The substantial relationship found between consanguineous marriages and ocular abnormalities (25%) in our study population is consistent with Ahmad's (2020) research in South Asian populations, which demonstrated a 2.3-fold increased risk of congenital visual defects in the offspring of consanguineous parents [9].

The high prevalence of strabismus (37.5%) and refractive errors (35.9%) in the present study population is comparable to findings by Martinez et al. (2023), who reported rates of strabismus as 40.2% and refractive errors 38.1% respectively in their multicenter study of children with neurodevelopmental disorders [10]. However, our observed rate of nystagmus (14.1%) is notably higher than the 8.3% reported in Williams' (2022) European cohort study, possibly reflecting population-specific genetic or environmental factors [11].

A strong relation between visual impairments and developmental delay found in our study (28.1% of cases) supports Morelli's (2023) findings that early visual problems can significantly impact developmental trajectories [12]. This reinforces the importance of early visual assessment in children with developmental delays, as emphasized by Kumar et al. (2023) in their longitudinal study [13].

Our finding that 71.4% of children with Down syndrome had visual impairments aligns closely with Nanda's (2016) study findings [14]. The high occurrence of refractive errors in this subgroup supports the need for regular ophthalmological screening, as recommended by the International Down Syndrome Medical Care Guidelines [15].

The predominance of corrective glasses (39.1%) as the primary intervention strategy reflects current best practices, though we found the rate is slightly lower than the 45% reported by Rodriguez et al. (2023) in their multinational study [16]. The relatively low rate of surgical interventions (6.3%) compared to Park's (2022) reported rate of 12.5% may indicate differences in healthcare access or clinical decision-making protocols [17].

Our findings support Lee et al.'s (2023) recommendation for comprehensive visual screening protocols in neurodevelopmental clinics [18]. The high rate of multiple ocular conditions (42.2%) emphasizes the need for thorough assessment approaches, as suggested by recent clinical guidelines [19]. The significant burden of visual impairments in our study population underscores Patel's (2023) assertion that integrated care approaches are essential for optimal outcomes in children with neurodevelopmental disorders [20]. Our findings particularly emphasize the need for early screening and intervention programs, supporting Gall's (2022) comprehensive care model for pediatric neurodevelopmental disorders [21].

## 7. Conclusion

This study provides valuable insights into the prevalence and patterns of visual impairments and ocular disorders among Bangladeshi children with neurodevelopmental disabilities. Our findings demonstrate that visual impairments are highly prevalent in this population, emphasizing the need for comprehensive ophthalmological screening as an integral part of their routine care. Strabismus and refractive errors are the most common ocular disorders. The study highlights several critical points with significant clinical implications:

1. The substantial relationship between consanguinity and ocular disorders underscores the importance of genetic counseling and early screening in high-risk families.
2. The predominance of urban participants reveals potential healthcare access disparities, suggesting the need for improved eye care services in rural areas.
3. The effectiveness of various management approaches, particularly corrective glasses demonstrates the potential for significant improvement in visual outcomes with appropriate intervention.
4. The higher prevalence of visual impairments in specific conditions (i.e., Down syndrome) supports the need for condition-specific screening protocols.

## 8. Limitations

1. The single-center nature of the study limits generalizability.
2. The cross-sectional design prevents the assessment of temporal relationships.
3. Potential referral bias due to the urban location of the study center.

## 9. Recommendations

1. Enhancement of awareness among healthcare providers about the high prevalence of visual impairments in children with neurodevelopmental disabilities.
2. Integration of ophthalmological care into routine neurodevelopmental follow-up for significant improvement of the quality of life.
3. Further longitudinal research to track visual outcomes over time in this population.
4. Investigation of intervention effectiveness in specific neurodevelopmental subgroups.
5. Development of targeted screening protocols for high-risk populations.
6. Assessment of socioeconomic factors influencing access to eye care services.

## Abbreviations

ASD	Autism Spectrum Disorder
ADHD	Attention Deficit Hyperactivity Disorder

## Author Contributions

**Tanjina Sharifa:** Conceptualization, Formal Analysis, Funding acquisition, Methodology, Project administration, Software, Supervision, Validation, Writing – original draft

**Kazi Shabbir Anwar:** Conceptualization, Funding acquisition, Investigation, Project administration, Resources, Visualization, Writing – review & editing

**Alima Taizu:** Data curation, Project administration

**Rezwana Khadija:** Data curation, Project administration

**Halima Sadia Rahman:** Resources, Supervision

## Conflicts of Interest

The authors declare no conflicts of interest.

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