Original Article

Frequency of Ocular Manifestations in Developmentally Delayed Children

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ABSTRACT

Purpose: To study the frequency of ocular abnormalities in developmentally delayed children of a private pediatric ophthalmology clinic.

Study Design: Observational cross-sectional.

Place and Duration of Study: Children eye care, Lahore, from October 2020 to October 2022.

Methods: Children aged five years and younger referred by a pediatrician for visual assessment were included in the study. The referring pediatrician made diagnosis of delayed milestones. A detailed ocular examination was done to rule out presence of any ocular abnormality. Data were collected, and statistical analysis was done using Excel (Microsoft 2015, version 15.15) and Stata (version 13).

Results: A total of 406 children were included in the study. Forty one percent were in the age bracket of 1 – 2 years. There were 63% boys. Among all, 77% had compromised vision, of which 60% had abnormal ocular findings, while cortical visual impairment (CVI) was seen in 17%. The most common ocular issue was refractive error (30.29%), of which hyperopia was seen in 70.7% and myopia in 29.3%. Strabismus was seen in 15.5% of children and exotropia being more prevalent. Visual delay was detected in 19.8%. Out of these 42% had hyperopia, whereas 21% had esotropia.

Conclusion: The significant association of ocular abnormalities with development delay is a cause of great concern as this can lead to an increase in overall morbidity. A timely examination by a pediatric ophthalmologist would lead to early detection of any ocular abnormality and convenient management, preventing undue visual impairment.

Key Words: Developmental delay, Strabismus, Hyperopia, Nystagmus, Cortical visual impairment, Visual delay.

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INTRODUCTION

Developmental delay refers to a lag in child's ability to develop skills and abilities that are typically required at a certain age.[1] These skills and abilities are categorized into five developmental domains: gross motor, vision, fine motor, speech, hearing, language, and social/personal.[2] Developmental delays can be caused by various factors, including genetics, environmental exposures, and medical conditions.[3]

Children experiencing developmental delay may take longer to reach certain milestones, such as learning to walk, talk or see, compared to children of their age.[4] Childhood developmental delay is associated with poor subsequent educational attainment and lower income during adult life, contributing to a cycle of poverty.[3] It is a substantial public health issue in many low and middle-income countries, such as Pakistan. The prevalence of developmental delays varies depending on the specific type of delay and the population being studied. In the United States, the Centers for disease control and

prevention (CDC) estimates that about 1 in 6 children, aged 3 – 7 years have one or more developmental disabilities.[5] Pakistan does not have a national database to track prevalence of developmental delays. Based on data from other developed countries, we can estimate that developmental delays occur in 10%–15% of children.[6]

In developmentally delayed children, specific deficits often go untreated due to lack of diagnosis or knowledge of their importance by both the physician and the caregivers. Ocular changes are often present in these children, and these findings may be related to the underlying cause of developmental delay or maybe as a separate entity.[7] Assessment of visual deprivation is the most complex, yet neglected challenge when handling developmentally delayed children.[8] Monitoring a child's developmental milestones can help to identify any delays or issues with visual development. Thus, it is essential for the health care provider to be familiar with the standard visual milestones of a child to enable him/her to detect any visual delay[9] (table 1).

Table 1: Visual milestones of a child.

Visual Milestone	Age
Eye contact	8 weeks
Social smile	3 months
Awareness of hands	3 months
Goal directed hand arm movements	5 – 6 months
Face recognition	7 – 10 months
Putting objects in and out of containers	12 – 18 months (about 1 and a half years)
Scribbling	18 – 24 months (about 2 years)

Infants at risk of delayed visual development should have an eye examination as early as 2 – 3 months of age.[9] Vision should be evaluated before any rehabilitation is initiated, so that defective vision is analyzed, managed, and included in early intervention.

This study was designed to identify and study the frequency of ocular abnormalities in developmentally delayed children in a private setup. There is no evidence of any study conducted in Pakistan evaluating ocular problems in developmentally delayed children. We hope to highlight the importance of early diagnosis of ocular disorders in developmentally delayed children — the most underserved and neglected members of society and open doors to further research and policy-making avenues.

METHODS

A cross-sectional observational study was conducted in 'Children eye care', a pediatric ophthalmology set-up, from October 2020-October 2022. The study included children aged five years and younger whom a certified pediatrician referred for visual assessment. The referring pediatrician made the diagnosis of delayed milestone. History, including the age of presentation, duration of symptoms, and presenting complaints, were noted. Visual acuity was assessed with the help of age-appropriate tests. Central, steady, and maintained fixation was taken as expected for a preverbal child. Any deviation from the norm was taken as abnormal. In verbal children, 6/18 or less was considered as abnormal vision. A thorough anterior segment examination followed by a dilated posterior segment evaluation was done in all children. Cycloplegic refraction was conducted in all study participants, followed by a post-mydriatic test when appropriate. A complete orthoptic assessment was done to exclude the presence of any ocular deviation. A detailed dilated fundus examination was done. In the case of media opacity, B-scan was asked for.

Data was gathered and entered into the password-secured personal computer of the prime researcher. A code was assigned to each participant instead of any identifying information. Once data was collected, and the survey closed, statistical analysis was conducted in Excel (Microsoft 2015, version 15.15) and Stata (version 13).

RESULTS

A total of 406 children were included in the study. The maximum number of patients were in the age bracket of 1 – 2 years (Figures 1). There were 255 boys and 151 girls.

Ocular abnormalities were detected in60% of children while CVI was seen in 17% of children. Table 1 is representative of the ocular findings in these children. Nystagmus was the most frequent presentation, followed by refractive error, with hyperopia being the most prevalent.

Refractive error was seen in 30.2% of the children, with hyperopia in 70.7% and myopia in 29.2% of the children with refractive error. Strabismus was seen in 15.5% (63) children ,esotropia (65%) being the more prevalent then exotropia (34.9%) of children with strabismus. Children diagnosed with nystagmus and visual delay had a high incidence of hyperopia (61%

and 42%, respectively). Esotropia was seen in 21% of children suffering from visual delay (Figure 2).

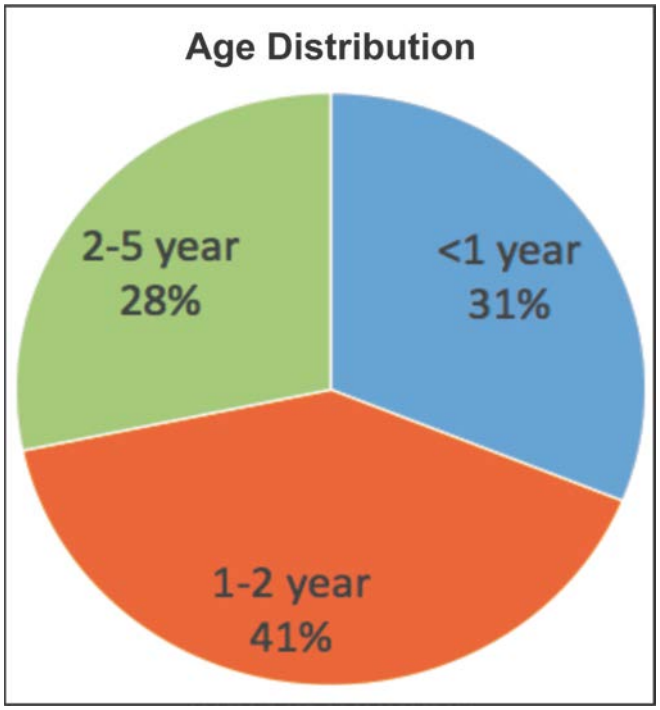

Figure 1: Age distribution of study participants.

Table 1: Ocular findings represented by numbers and percentages.

Ocular Findings	N (Patients)	Percentage
Nystagmus	197	48.5
Visual delay	81	19.9
CVI	69	16.9
Refractive error	123	30.2
Strabismus	63	15.5
Optic atrophy	19	04.6
Cataract	24	5.9
Optic disc coloboma	02	0.4
Microphthalmia	02	0.4
No ocular disorder	93	23.3

DISCUSSION

Prevalence of childhood disabilities is up to 10% of the total pediatric population and this figure is much higher in Pakistan.[10] It has been estimated that around 200 million children under five do not attain their developmental potential due to multiple causes. Undetected visual impairment combined with other handicaps is likely to have an adverse effect on development and may lead to an underestimation of intellectual ability.[11] Early identification of ocular findings in children with developmental delay helps to prevent or mitigate any adverse effects on visual and overall development, thus improving the quality of life. Ocular issues also affect a child's ability to learn and perform in school. Identifying and treating them can help to ensure that these children have the best possible opportunities for learning and development.

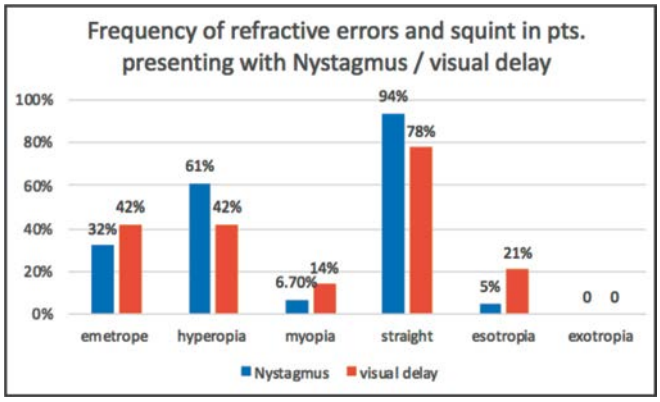

Figure 2: Frequency of refractive errors and squint in patients (pts.) with nystagmus and visual delay.

In our study, 406 developmentally delayed children under the age of five were screened over a period of two years. The number of male children was more than female. This was in accordance with studies conducted by Smitha et al.[12] Similarly, Afroze R, in a study conducted in Bangladesh found a preponderance of boys.[13]

Very few studies are available for ocular manifestations under 5 years of age. Our study found maximum patients in the age group of 1 – 2 years (42%), which follows similar studies conducted in Karnataka and Mumbai.[2]Smitha et al. found 28.63% in the age group 6 months–1 year and 35.8% in 1–3 years.[12] This is likely because the parents are more conscious about their child's vision at this age and thus look out most for medical help.

In our study, 77% of children had compromised vision, with abnormal ocular findings in 60% of these children and CVI in 17%. The same was evident in the study by Smitha et al. (83.6%)[12], Akinci et al, (77%),[14] Chandrakishore and Sujata (86%)[15] and Afroze R (65.7%).[13] Taking into consideration the above statistics, not enough stress can be paid to the importance of early eye examination by a pediatric ophthalmologist.

The most common ocular problem was refractive

error (30.29%), of which hyperopia was seen in 70.7% and myopia in 29.3%. In their study, Smitha KV et al,[12] reported similar findings with refractive errors in 59.7% of cases. Chandrakishore and Sujata, however, reported cataracts (20%) to be more common than refractive error.[15] In our study, 24 children (5.9%) had cataract. Congenital cataract in these children is mostly associated with rubella infection and inherited developmental disorders.[16] There should be protocols for screening these children for cataract and planning timely management.

Sixty three children (15.5%) presented with strabismus, esotropia being the predominant entity. Afroze R,[13] reported the prevalence of strabismus to be 22.5%, with esotropia (12.7%) being more common than exotropia (9.8%) which is in accordance with the study of Nielsen et al.[17]

Nystagmus was seen in 225 (55.4%) children. These children performed goal-directed hand movements slowly and with difficulty. Cycloplegic retinoscopy was done, and hyperopia was seen in 61% of these children. However, in a study conducted in Karachi, there was no preponderance of hyperopia; this may be because the age bracket of the patients was 5 – 15 years.[18]

Visual delay was detected in a significantly high number (19.8%) of children, and interestingly, 42% of these children were hyperopic, while 21%had esotropia. Visually challenged infants with poor or absent accommodation with or without hyperopia must deal with blurred near vision. As a result, they are unable to develop accommodation and convergence. These children have a substantial risk of being labeled as non-seeing or autistic because of poor or no eye contact. This can mislead a healthcare worker into giving a wrong diagnosis of autism.[19] The treatment of these children may not begin in the crucial first year of life, leading to severely impaired vision in future. There is ample evidence suggestive of an association between uncorrected hyperopia and abnormal visual development and learning disability.[20]

Thus, it is highly imperative to do a cycloplegic retinoscopy in every child with a poor visual response, irrespective of the age of presentation, to detect the presence of refractive error. Giving them right glasses and visual training can have miraculous results. This not only improves vision but also has a positive effect on motor and cognitive skills, as well as social interactions of the child.[21]

Children with a poor visual response, which cannot be explained by any ocular abnormality, should be labeled as having a cortical visual impairment (CVI).[22] When there is damage to the visual pathway posterior to chiasma, it results in disruption of visual processing. Most children with CVI are developmentally delayed, and early diagnosis is crucial for rehabilitating these children.[11] In our study, CVI was seen in 65 children (21.6%). Damage to the visual parts of the brain due to any cause such as premature birth, insufficient oxygenation, antenatal or postnatal infection of the baby, brain malformation, hydrocephalus, seizure in infant life, and metabolic disease can result in CVI.[23] This information can help design interventions at the grass root level to prevent CVI and lift the economic burden from the families and at the state level.

Limitations of this study was a single center study and a private setup. Public sector pediatric ophthalmologists may have different figures than this due to difference in the economic status of children. Further studies need to be done at provincial and national level to tackle this highly important problem.

CONCLUSION

Once the child is labeled as developmentally delayed, the caregivers and the child must fight on multiple fronts. Visual compromise plays a detrimental role in increasing overall morbidity. A timely examination by a pediatric ophthalmologist would lead to early detection of any ocular abnormality and timely management, preventing undue visual impairment.

Conflict of Interest

Authors declared no conflict of interest.

Ethical Approval

The study was approved by the Institutional review board/Ethical review board **(OSP-IRB/005-2023).**

REFERENCES

1. **Choo YY, Agarwal P, How CH, Yeleswarapu SP.** Developmental delay: identification and management at primary care level. Singapore Med J. 2019; **60 (3):** 119-123. Doi: 10.11622/smedj.2019025.

2. **Hegde V, Jain R, Bappal A, Shambhu R.** Ocular manifestations in children with developmental delay at a tertiary center in South India. Saudi J Ophthalmol. 2021 Sep. 9; **35 (1):** 1-4. Doi: 10.4103/1319-4534.325773.
3. **Khan MA, Owais SS, Blacklock C, Anil S, Ishaq S, Maqbool S, et al.** Delivering integrated child development care in Pakistan: protocol for a clustered randomised trial. BJGP Open, 20179; **1 (1):** bjgpopen17X100677. Doi: 10.3399/bjgpopen17X100677.
4. **Zhang J, Guo S, Li Y, Wei Q, Zhang C, Wang X, et al.** Factors influencing developmental delay among young children in poor rural China: a latent variable approach. BMJ Open, 2018 Sep 1; **8 (8):** e021628. Doi: 10.1136/bmjopen-2018-021628.
5. Developmental Disabilities | CDC [Internet]. Available from: https://www.cdc.gov/ncbddd/developmentaldisabilities/index.html. Accessed 23 December 2022.
6. **Gupta S, Shrivastava P, Samsuzzaman M, Banerjee N, Das DK.** Developmental delay among children under two years of age in slums of Burdwan Municipality: A cross-sectional study. J Family Med Prim Care, 2021; **10 (5):** 1945-1949. Doi: 10.4103/jfmpc.jfmpc_1926_20. Epub 2021 May 31.
7. **Joshi MS, Telang OJ, Morepatil VG.** Ocular disorders in children with developmental delay. J. Evid. Based Med. Healthc. 2017; **4 (68):** 4065-4070. Doi: 10.18410/jebmh/2017/811
8. **Adio AO, Bodunde OT, Hyvärinen L.** The importance of detecting delays in the development of visual functioning and signs of disorders of the eyes during the 1 st year of life: An African perspective. Sub-Saharan Afr J Med. 2015; **2 (4):** 149-153.
9. "Delayed Visual Development: Development of Vision And Visual Delays". American Academy of Ophthalmology, 2016. https://www.aao.org/education/disease-review/delayed-visual-development-development-of-vision-v. Accessed 1 Mar 2023.
10. **Shazia M, Ullah S, Butt T, Zahra, W. Shariff MM.** Developmental assessment and effect of intervention in children with global developmental delay. Pak Paediatr J. 2011; **35:** 139-144.
11. **Boonstra FN, Bosch DGM, Geldof CJA, Stellingwerf C, Porro G.** The Multidisciplinary Guidelines for Diagnosis and Referral in Cerebral Visual Impairment. Front Hum Neurosci. 2022; **16:** 727565. Doi: 10.3389/fnhum.2022.727565.
12. **Smitha K, Harshavardhan P, Patil S, Bhagyajyoti B, Sheetal V.** Prevalence of ocular manifestations in children with developmental delay. Medica Innovatica. 2014; **3 (2):** 42-44.
13. **Afroze R, Islam K, Huq S.** Ocular manifestations in children with developmental delay in an eye hospital of northern Bangladesh. Int J Community Med Public Health, 2021; **8 (12):** 5682.
14. **Akinci A, Oner O, Bozkurt OH, Guven A, Degerliyurt A, Munir K.** Refractive errors and ocular findings in children with intellectual disability: a controlled study. J AAPOS. 2008; **12 (5):** 477-481. Doi: 10.1016/j.jaapos.2008.04.009
15. **Pardhi CH, Chahande SS.** Ophthalmic manifestations in children with delayed milestones. J Clin Ophthalmol Res. 2020; **8 (1):** 18-23.
16. **Panneerselvam S, Chilakapati M, Moisiuc A, Yen KG, Panneerselvam S, Chilakapati M, et al.** Management of Cataracts in Pediatric Patients with Developmental Delay at a Tertiary Care Pediatric Hospital. Open J Ophthalmol. 2021; **11 (2):** 152–62.
17. **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 (2):** 149-156. Doi: 10.1111/j.1600-0420.2006.00867.x.
18. **Perveen K, Ahmed N, Perveen K, Mehmood T.** Refractive Error in Juvenile Patients Presenting with Nystagmus at Tertiary Care Hospital of Karachi. J Bahria Uni Med Dent Coll. 2021; **11 (3):** 112–115. Doi: 10.51985/ZDVZ6566
19. **Levinsen M, Børresen ML, Roos L, Grønskov K, Kessel L.** Causes of poor eye contact in infants: a population-based study. BMC Ophthalmol. 2021; **21 (1):** 388. Doi: 10.1186/s12886-021-02151-7.
20. **Ntodie M, Saunders KJ, Little JA.** Correction of Low-Moderate Hyperopia Improves Accommodative Function for Some Hyperopic Children During Sustained Near Work. Invest Ophthalmol Vis Sci. 2021; **62 (4):** 6. Doi: 10.1167/iovs.62.4.6.
21. **Sauer T, Lawrence L, Mayo-Ortega L, Oyama-Ganiko R, Schroeder S.** Refractive error and ocular findings among infants and young children with severe problem behavior and developmental disabilities. J Ment Health Res Intellect Disabil. 2018; **11 (4):** 251-265. Doi: 10.1080/19315864.2018.1497108
22. **McConnell EL, Saunders KJ, Little JA.** What assessments are currently used to investigate and diagnose cerebral visual impairment (CVI) in children? A systematic review. Ophthalmic Physiol Opt. 2021; **41 (2):** 224-244. Doi: 10.1111/opo.12776. Epub 2020 Dec 27.
23. "Cortical Visual Impairment - American Association for Pediatric Ophthalmology and Strabismus". Aapos. Org. 2023, Available at: https://aapos.org/glossary/cortical-visual-impairment. Accessed 1 Mar 2023.

Authors' Designation and Contribution

Ashvinah Qayyum; House Officer: *Concepts, Design, Literature search, Data acquisition, Data analysis, Manuscript preparation.*

Muhammad Ahmed Qayyum; Student: *Design, Data analysis, Statistical analysis, Manuscript editing.*

Fizza Naz Farooqi; House Officer: *Concepts, Literature search, Manuscript editing.*

Seema Qayyum; Professor: *Concepts, Data acquisition, Manuscript review.*

Disclaimer

At the time of study all the authors were in the institute where study was conducted.