REVIEW
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Prevalence of pediatric eye diseases in Assam, India — a hospital-based retrospective data

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ABSTRACT

BACKGROUND: In a hospital setting, paediatric eye disease manifests itself in a complex network. It is essential to comprehend the scope of many common eye disorders in order to develop new evidence-based strategies for mitigating such disorders. The study aimed to investigate the hospital-based prevalence of pediatric ocular disorders of patients attending a tertiary eye care hospital.

MATERIAL AND METHODS: A three-year data from 2017-19 were extracted from the electronic medical records of Chandraprabha Eye Hospital, Assam, India. Refining the data was further carried out using the age criteria up to 18 years. The diagnosis for all the study subjects was taken into consideration and was further analyzed. The inclusion criteria included subjects within the range of 0-18 years reporting to the hospital during the study period. Subjects diagnosed with non-ocular problems, incomplete ophthalmological assessments, and those aged more than 18 years were excluded.

RESULTS: A total of 11807 relevant medical records were reviewed. Among the study subjects, 58.52% (n = 6910) were males. The mean (SD) age was 11.9 (4.8) years. Of the subjects 21.28% (n = 2513) were in age group 0–5 years, 42.39% (n = 5006) — in 6–11 years, and 36.31% (n = 4288) in 12–18 years. A total number of 152 pediatric ocular abnormalities were identified from the reviewed files. Myopia alone accounted for 19% of all, followed by vernal keratoconjunctivitis with 14.7%, followed by asthenopic presentation associated with non-strabismic binocular vision anomalies (7.4%), congenital nasolacrimal duct obstruction (2.9%), amblyopia (2.8%), and ocular injuries (2.7%).

CONCLUSIONS: Refractive errors, allergic conjunctivitis, ocular injuries, amblyopia and squint, uveitis, congenital cataract, and non-strabismic binocular vision anomalies were identified as the most common pediatric ocular abnormalities seen in routine clinical practice, laying the groundwork for a standard protocol to evaluate and assess visual function in any case of pediatric anomaly.

KEY WORDS: pediatric eye disease; refractive errors; prevalence

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INTRODUCTION

Vision is the primary component for an individual to perceive the world. The learning target begins in infancy, and the precision of a child's vision can significantly affect or change the learning ability. The more a problem with vision continues unaddressed, the more the child's brain learns to overcome the issue with vision. Several pediatric ocular abnormalities have been reported in the existing literature, which aims at portraying an epide-

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miological figure of anterior and posterior pediatric eye diseases in various parts of the world [1–4]. The World Health Organization (WHO) estimates that visual impairment affects 19 million children worldwide, often caused by uncorrected refractive errors, accompanied by untreated cataracts and glaucoma [5]. With proper medical consultation and effective treatment, 80% of visual impairments can be prevented [5].

Eye diseases and visual impairments in a child can develop several socio-economic problems. The pattern of childhood vision impairment has drastically changed in this present scenario compared to the 20th century. In a comparative data of trajectory change in childhood blindness between 1993 and 2006, the prevalence of disorders associated with visual impairment has increased [6]. Therefore, childhood eye diseases should be given priority, in particular in developing countries. Ironically, the hospital-based epidemiological studies of pediatric eye disease in Assam are confined. A cross-sectional study conducted at schools of Guwahati, Assam, showed a prevalence of myopia in about 81.92% [7]. Another study carried out at the Government schools of Dibrugarh, Assam, found approximately 39% of the school-going children had a refractive error [8]. A prevalence of 1.75% amblyopic cases was reported in an observational study based on community outreach at Assam, which provides a rationale for school screening initiative need and appropriate referral and management. [9] Another community-based observational study found that refractive errors, allergic conjunctivitis, adnexal infections, and ocular trauma are common in rural areas of Assam. In contrast, uncorrected refractive errors along with cataracts and strabismus are more prevalent in urban areas [10]. Based on the above consideration, we aimed to present the hospital-based prevalence of pediatric ocular disorders of patients attending a tertiary eye care unit in Jorhat, Assam.

MATERIAL AND METHODS

This retrospective study was conducted at Chandraprabha Eye Hospital, Jorhat Assam. The study was approved by the institutional review board and adhered to the tenets of the Declaration of Helsinki. The inclusion criteria included subjects within the range of 0–18 years reporting to the hospital during the study period. Subjects diagnosed with non-ocular problems, incomplete ophthalmological assessments, and those aged more than 18 years were excluded. The operational definitions of common eye disorders are tabulated in Table 1.

Table 1. Operational definitions of the common eye diseases

Myopia	A condition in which the spherical equivalent objective refractive error is ≤ −0.50 D in either eye [11]
Emmetropia	A state between myopia and hyperopia, in which "when parallel rays strike a physiologically normal eye, they are refracted to converge upon the retina, where they focus, forming a circle of least confusion with the eye in a state of rest [12]
Amblyopia	Unilateral or bilateral reduction in the visual acuity caused by pattern deprivation or abnormal binocular interaction, for which no cause could be detected in the physical examination of the eye and which also could be reversed by therapeutic measures in some cases [13]
Vernal keratoconjunctivitis (VKC)	Allergic inflammation of the ocular surface, involving the tarsal and/or bulbar conjunctiva that is persistent, bilateral, at times asymmetrical, and seasonally aggravated [14]
Congenital nasolacrimal duct obstruction (CNLDO)	Failure of the nasolacrimal duct drainage system, resulting in overflowing tears (also known as "epiphora") [15]
Ocular injuries [16]	Closed globe injury: No full-thickness wound of eye wall Open globe injury: Full-thickness wound of the eye wall Contusion: It is no (full-thickness) wound. This might be due to either direct energy delivery by the object or the changes in the shape of the globe Laceration: Full-thickness wound of the eyewall, caused by a sharp object Penetrating injury: Entrance wound Perforating injury: Entrance and exit wound
Chemical burns	Injuries caused by either acid or alkali [17]
Keratitis	Corneal inflammation characterized by corneal edema, inflammatory cell infiltration, and ciliary congestion [18]

Table 1. Operational definitions of the common eye diseases	
Keratoconus	A condition that causes increasing corneal protrusion and thinning, resulting in irregular astigmatism and visual impairment [19]
Congenital corneal opacity	group of diseases associated with loss of transparency in the corneal tissue at birth or during the first 4 weeks of life [20]
Corneal dystrophy	a spectrum of inherited corneal abnormalities that are usually bilateral, symmetric, and slowly progressing, with no link to environmental or systemic influences [21]
Congenital cataract	opacification of the crystalline lens appearing at birth or shortly after [22]
Dacryocystitis	an inflammation in the nasolacrimal sac, typically caused by an obstruction within the nasolacrimal duct and subsequent stagnation of tears in the lacrimal sac [23]
Uveitis	Inflammation of the uvea, which is comprised of the iris, ciliary body, and choroid. However, any part of the eye can be inflamed. Based on the major anatomical site of the inflammation in the eye, uveitis is further categorized into anterior, intermediate, posterior, and pan-uveitis [24]
Coloboma	Absence of uveal (iris, ciliary body, choroid) tissue inside the eye [25]
Persistent hyperplastic primary vitreous	Developmental abnormality of the eye in which the embryonic vitreous and hyaloid vasculature do not fully form [26]
Marcus Gunn Jaw-Winking Syndrome	Type of neurogenic congenital ptosis characterized by the movement of one upper eyelid in a rapid rising motion each time the jaw moves [27]
Down's syndrome	A genetic disorder resulting from dosage imbalance of genes located on human chromosome 21 (Hsa 21) [28]
Goldenhar syndrome	An unusual congenital disorder marked by severe craniofacial abnormalities as well as deformities of the spine, heart, kidneys, central nervous system, and gastrointestinal tract [29]
Marfan's syndrome	A variable, autosomal-dominant disorder of connective tissue usually linked with a mutation in fibrillin, and occasionally with a mutation in TGFBR1 or 2 [30]
Congenital nystagmus	Eye movement abnormality associated with involuntary oscillations of one or both eyes [31]
Cerebral palsy	A group of persistent disorders affecting the development of movement and posture, causing activity limitation that is linked to non progressive disturbances occurring in the developing fetal or infant brain [32]
Congenital glaucoma	A developmental condition occurring before the age of three years due to an obstruction preventing uniform drainage of aqueous humor caused by abnormal development of the trabecular meshwork (TM) and anterior chamber angle [33]
Retinopathy of prematurity	Vaso-proliferative abnormality of the retina, commonly seen among preterm infants [34]
Lattice degeneration	A peripheral retinal degeneration associated with localized retinal thinning, overlying vitreous liquefaction, and marginal vitreoretinal adhesion [35]
Retinal detachment	Separation of the neurosensory retina from retinal pigment epithelium [36]
Ocular albinism	An autosomal recessive anomaly accompanied by complete absence or reduction of biosynthesis of melanin in melanocytes [37]
Chalazion	Inflammatory, slow enlarging lesions of the eyelid occurring due to inflammation and obstruction of sebaceous glands of the eyelids [38]
Stye	Acute or chronic inflammation of the meibomian gland or gland of zeis in the eyelid [39]
Astigmatism	A refractive error where rays of light do not form a point focus; instead form two foci due to un uniformity in the refractive media of the eye [40]

Statistical analysis

A three-year data from 2017–19 were extracted from the hospital's electronic medical records and were reviewed. Refining the data was further carried out using the age criteria up to 18 years. The diagnosis for all the study subjects was taken into consideration and was further analyzed. The outcome variable basically included the diagnosis made during the time of visit. Data were analyzed using Statistical Package for Social Sciences (SPSS). Parametric method and univariate analysis were used to calculate the frequency and percentage.

RESULTS

Age and sex distribution

A total of 11,807 subjects were recruited, of which 58.52% (n = 6910) were males. The mean (SD) age was 11.9 (4.8) years. Of the subjects 21.28% (n = 2513) were in age group 0–5 years,

Table 2. Frequency and percentage of anterior segment ocular disease

Disease	Number	Percentage
Corneal diseases		
Defect epithelial cornea	119	1.00
Disciform keratitis	2	0
Keratoconjunctivitis	101	0.9
Congenital cornea opacity	48	0.4
Viral keratitis	15	0.1
Keratoconus	7	0.1
Corneal dystrophy	1	0
Keratitis bacterial	149	1.3
Keratomalacia	2	0
Keratopathy band shaped	2	0
Sclerocornea	1	0
Ocular surface disorders		
Stevens Johnson syndrome	2	0
Xerophthalmia	4	0
Dry eye syndrome	3	0
Conjunctival disorders		
Vernal keratoconjunctivitis	1742	14.7
Blepharoconjunctivitis	55	0.5
Sessile papilloma	3	0
Neonatorum ophthalmia	1	0
Subconjunctival hematoma	21	0.2
Viral conjunctivitis	19	0.2
Conjunctival cyst	24	0.2
Giant papillary conjunctivits	1	0
Pterygium	2	0

Disease	Number	Percentage
Eyelid disorders		
Chalazion	262	2.2
Telecanthus	2	0
Molluscum contagiosum eyelid	4	0
Stye	191	1.6
Blepharitis	103	0.9
Madarosis	3	0
Euryblephron	3	0
Ptosis congenital	41	0.3
Entropion	17	0.1
Blepharospasm	8	0.1
Lid benign mass	6	0.1
Trichiasis without entropion	1	0
Eyelid cyst	3	0
Meibomitis	51	0.4
Blepharophimosis	1	0
Lens disorders		
Congenital cataract	166	1.4
Traumatic cataract	17	0.1
Aphakia	16	0.1
Subluxation of lens	7	0.1
Dislocation lens	6	0.1
Congenital cataract associated with rubella syndrome	3	0
Lenticonus congenital	1	0
Spherophakia	1	0

42.39% (n = 5006) — in 6–11 years, and 36.31% (n = 4288) in 12–18 years. A total number of 152 pediatric ocular abnormalities were identified during the study period.

Refractive error and associated anomalies

Myopia was the most common refractive error being found (19.10%), followed by astigmatism (15.50%), hyperopia (1.80%), and anisometropia (0.20%). The prevalence of emmetropia was 10.90. However, the prevalence of amblyopia was 2.80%, which comprised all its forms, including refractive, strabismic, anisometropic, and meridonial. The prevalence of non-strabismic binocular vision anomalies versus squint was 7.40% *vs.* 1.2%.

Anterior segment ocular abnormalities

The most common anterior segment ocular abnormalities were: vernal keratoconjunctivitis (14.70%), congenital nasolacrimal duct obstruction (2.90%), chalazion (2.20%), stye (1.60%), congenital cataract (1.40%), bacterial keratitis (1.30%), and corneal epithelial defect (1.00%) (Tab. 2)

Posterior segment ocular abnormalities

The most common posterior segment ocular abnormalities found were: retinopathy of prematurity (0.60%), lattice degeneration (0.50%), retinal detachment (0.30%), choroidal coloboma (0.30%) and vitreous hemorrhage (0.20%) (Tab. 3).

Other ocular anomalies

The less common ocular abnormalities noted were: microphthalmos, limbitis, preseptal cellulitis, episcleritis, proptosis, attention deficit hyperactivity syndrome (ADHD), anterior staphyloma, sebaceous cyst, endophthalmitis, phthisis bulbi, cortical blindness, enophthalmos, furunculosis, hydroceph-

Table 3. Frequency and percentage of posterior segment ocular disease

Disease	Number	Percentage
Optic nerve disorders		
Congenital glaucoma	12	0.1
Pseudopapilledema	1	0
Angle closure glaucoma	3	0
Atrophy optic	7	0.1
Neuritis optic	5	0
Optic nerve head coloboma	2	0
Neurofibromatosis	2	0
Papilledema	2	0
Retinal disorders		
Leucocoria	12	0
Retinopathy of prematurity	1	0.6
Lattice degeneration	3	0.5
Coloboma fundus	7	0.1
Ocular albinism	5	0.1
Macular cyst	2	0
Retinal detachment	2	0.3
Retinal vasculitis	2	0
Toxoplasmo retinal scar	2	0
Chorioretinitis toxoplasmic	2	0
Coats disease	68	0
Night blindness	64	0
Coloboma retina	9	0
Cysticercosis retina	8	0
Stargardt's disease	1	0
Retinitis pigmentosa	39	0
Retinoschisis flat	3	0
Scar chorioretinal	3	0
Scar macula	2	0
Vitreous disorders		
Haemorrhage vitreous	20	0.2
Persistent hyperplastic primary vitreous (PHPV)	2	0
Vitritis	3	0

alus, a child with low vision, nanophthalmos and panophthalmitis. However, there were diseases with miscellaneous ocular involvement (Fig. 1).

DISCUSSION

This study illustrates the clinical pattern of common pediatric eye diseases, reporting a tertiary eye care center. Refractive error was one of the most common conditions noted, in which myopia alone accounts for 19.1%. A meta-analysis carried out by Holden et al. (2016), estimated a global prevalence of 1406 million individuals with myopia and about 163 million with high myopia. As per the increasing trend of myopia, a prediction of 50% of the world's population developing myopia by 2050 was made too [41]. Prolonged near work and lesser outdoor activity are well-established risk factors for myopia progression. [42] Our study results showed that 50% of the cases among the myopic individuals are associated with near work, which is consistent with the review proposed by Grzybowski et al. (2020) [42]. This portrays the need for adapting necessary strategies to control myopia prevalence in hospital-based scenarios and a community setting.

Another noticeable result in this study was vernal keratoconjunctivitis (VKC), with a prevalence rate of 14.7% (n = 1742). The Allergies in Asia Pacific Study (AIAP) [43, 44] indicated that VKC is common among adults and school-going ages and affects their quality of life, school performance, and productivity. In their study, Duke et al. (2016) [45] found that 18.1% of the school-going children presented various grades of VKC. A similar result was found in our study. The subjects presented a gelatinous infraction with Trantas dots and a few with papillae, suggesting the association of the typical three clinical types of VKC.

Non-strabismic binocular vision anomalies (NSBVA) associated with asthenopic symptoms have been well documented in the existing literature [46–49]. Hussaindeen et al. (2017), in a population-based study, found that 31.5% in urban and 29.6% rural school-going children had NSBVA with a fact of the increase in the near visual demands thus, hampering their academic performance [49]. Convergence insufficiency was the most common NSBVA reported in both urban (93%) and rural (63%) children. Similar findings were portrayed in a cross-sectional study at Guwahati, Assam, by Magdalene et al. (2017). Authors found that approximately 70% of subjects between 10 and 20 years had NSBVA, with the most common convergence insufficiency [48]. This study result was in accordance with the previously reported studies, where 7.4% (n = 887) subjects had NSBVAs. However, the prevalence rate was not limited to either rural or urban populations due to the lack of specific information in patients' medical records. Moreover, the higher frequency reflects an upward tendency in convergence and accommodative abnormalities,

which may be impacted by variables such as decreased outdoor activity, increased gadget usage, and uncorrected refractive errors. On the other hand, the prevalence rate would assist clinicians in creating a plan for various screening and clinical approaches to help diagnose and manage such instances earlier.

Amblyopia and its associated risk factors have always played a major concern as it is associated with a 1.2% lifetime risk of visual loss [50]. The prevalence of amblyopia rates varies due to the considered population and the conflicting definitions used in various studies. A population-based study carried out by Faghihi et al. found a prevalence rate of 4.6% amblyopia [51]. In contrast to the previous findings, another population-based study in southern India, conducted by Ganekal et al. (2013) found an amblyopia prevalence of 1.1% [52]. However, our study results were not consistent with any of them. The possible explanation could be the variation and the primary outcome measures difference in various studies. Another reason explaining the same would be the age group and the definition considered for amblyopia.

Cakmak et al. (2004) investigated the ocular injury profile in an eye care clinic and found that approximately 70% of the cases account in the age group of 0–15 years, of which 95% of the cases were reported while playing [53]. These injuries further led to secondary complications such a retinal detachment, traumatic cataract, phthisis bulbi, and endophthalmitis. A similar pattern of ocular injuries of 2.7% (n = 325) was found in this study, along with 0.3% (n = 33) of cases with chemical injury. These results suggest a provision of emergency care in a tertiary eye care unit, along with proper tools available for assessment and management. However, the involvement of the ocular structures following the injury remains unclear due to variation in the documentation of the injury site, at the diagnosis pattern in the patients' medical records.

A congenital cataract is responsible for around a tenth of the world's childhood blindness [5, 55]. Since the etiology includes intrauterine infections, ionizing radiations, pre- and perinatal metabolic disorder, and hereditary means with and without associated syndromes [54], it becomes challenging for an eye care professional to rule out the exact cause and step with the intervention. Sheeladevi et al. (2016) in a systematic review, highlighted an overall global prevalence of 0.63 to 9.74/10000 children, respectively, with an incidence ranging from 1.8–3.6/10000 in high-income economies [55]. In contrast, the prevalence rate of childhood blindness owing to cataracts is about ten times higher in low-income nations than the higher-income ones [56]. However, in this study, a prevalence rate of 1.4% (n = 166) congenital cataracts were found, and (n = 3) were associated with syndromes. The results of this study are consistent with the study carried out by Mohan and Kaur (2017), where a total of patients (n = 165) were diagnosed with congenital cataracts, of which 72% were non-traumatic. Among them, a total of 5% (n = 6) had an association with rubella [57]. This implies a need for precautionary awareness during pregnancy and rubella vaccination to prevent further complications.

Retinopathy of prematurity is another increasing global trend for blindness. Limited health services in middle and low-income countries with geographic technical and capability differences may restrict the treatment of premature newborns, thus increasing the prevalence rate of ROP [58]. A retrospective 5-year data by Le et al. (2016) in South India found an incidence rate of 2.3% (n = 66) ROP, among which 71% had a stage 1 ROP [59]. Our results are inconsistent with the results from the former study, where 0.6% (n = 68) subjects had ROP. This suggests an effective screening protocol is vital to the timely detection and treatment of ROP.

On the other hand, neoplasms of the eye were found to be less common in this study. Olurin et al. (1971), described 191 histologically proven oculo-orbital tumors in the Nigerian population, of which two-thirds of the tumors were seen within the age of 20 years [60]. A study conducted by Modi et al. 2013 [61] in West India found retinoblastoma to be the common ocular tumor with a prevalence rate of 62% (n = 46). However, these findings did not correlate well with our results, where the severity and prevalence of ocular tumors were less common. The reason could satisfy the fact that the difference in the climatic perspective and change in geographical status might contribute to our findings.

Moreover, uveitis in pediatric ages has also been reported in the literature. Narayana et al. (2002), in a study conducted in southern India, found 6.29% of cases with pediatric uveitis involving all the types [62]. In 20 years of retrospective data from North India by Natasha et al. (2016) prevalence rate of pediatric uveitis was 3.8%, with anterior uveitis being common of all [63]. Our study results also portrayed a prevalence of 0.6% (n = 67) cases of uveitis, satisfying the results of the former studies.

Sarosh et al. 2018, in their 2-year study period, found 45.9% from 0–10 years and 29% within the age ranged from 10–20 years with a squint, of which esotropia was highly prevalent in approximately 60% [64]. In our study 1.2% of patients (n = 143) were diagnosed with ocular deviations. These results are inconsistent with mentioned findings. This builds up a matter of concern in managing these cases to prevent further development of secondary conditions like amblyopia if untreated. Thus, pediatric vision screening is thus a vital part of the early assessment of ocular conditions. Detecting vision-threatening ocular disorders early in the infant's development offers a huge opportunity to prevent further damage. The essential elements of infant screening are appropriate visual function assessment and rule out refractive errors, diagnosis of ROP, congenital cataract, corneal injury, retinoblastoma, strabismus, and amblyopia.

However, the limitation of the study includes the retrospective nature of the study design, limiting the diagnosis made with standard and uniform protocols due to variation in the diagnosis pattern from different examiners. Secondly, the outcome measures following management were not included owing to the loss of follow-up of maximum patients after their initial visit. Thus, future recommendations from this study include understanding the prevalence pattern of pediatric diseases in a longitudinal mode using proper diagnostic protocol and documentation of respective variables along with follow-up visits to understand the outcome of the treatment provided.

CONCLUSION

The study results highlighted refractive errors, allergic conjunctivitis, ocular injuries, amblyopia and squint, uveitis, congenital cataract, and non-strabismic binocular vision anomalies as the commonest pediatric ocular abnormalities seen in routine clinical practice. Our results set a base to evaluate precisely and assess the visual function in a standard protocol to be followed in any case of pediatric anomaly.

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