

Original Article

Clinical Profile of Strabismus among Children Attending a Tertiary Care Hospital in Eastern India

Arnab Mandal¹, Jaya Biswas², Pamela Pattanayak³, Mousumi Bandyopadhyay⁴

Abstract

Background : Strabismus is misalignment of visual axis of the two eyes when looking at an object of regard. Apart from visual morbidity, strabismus has got both cosmetic and psychosocial impact. Our study aimed at estimation of prevalence of different types of childhood strabismus, assess the visual status and determine the factors associated with childhood strabismus.

Materials and Methods : It was a cross-sectional, observational study conducted from February, 2020 to January, 2021 among children <18 years of age having strabismus who attended the Outpatient Department (OPD) of Ophthalmology of a Tertiary Care Hospital in West Bengal, India. Proper history taking, meticulous ophthalmological examinations and necessary laboratory investigations were done in all the cases.

Results : A total of 96 patients were included in our study. Hospital prevalence of childhood strabismus was 1.88%. Majority of the patients (39.6%) were of 5-10 years age group. The mean and median age at presentation was 7.5±4.9 and 7 years respectively. Males (58.3%) were more than females (41.7%). Majority of the patients belonged to the lower middle socioeconomic class (59.4%). Esotropia (55.2%) was the most common type of strabismus, followed by exotropia (35.4%). Most common refractive error was myopia (31.2%) and strabismic amblyopia (8.3%) was the most common type of amblyopia. Birth asphyxia (13.5%) was the most common factor associated with strabismus.

Conclusion : Strabismus is an important treatable cause of ocular morbidity in children. If left untreated, it may cause visual impairment and psychosocial problem. Hence early detection and treatment is needed.

Key words : Strabismus, Children, Esotropia, Myopia, Strabismic Amblyopia, Birth Asphyxia.

Strabismus is a common eye condition among children attending Ophthalmology Outpatient Department (OPD). Prevalence of strabismus ranges from 0.6 to 6.9% worldwide¹⁻⁴. Several factors including prematurity, birth asphyxia, birth trauma, Neonatal Intensive Care Unit (NICU)/Sick Neonatal Care Unit (SNCU) admission, Low Birth Weight (LBW), maternal smoking during pregnancy, Intrauterine Growth Retardation (IUGR), family history of strabismus and consanguineous marriage have been postulated to be associated with childhood strabismus. Ocular factors such as hyperopia, myopia, anisometropia, astigmatism and amblyopia are also associated with strabismus^{2,3,5-9}.

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Editor's Comment :

- Strabismus is an important cause of childhood ocular morbidity and cosmetic deformity.
- Early detection and treatment can prevent irreversible vision loss and psychological impact on children.
- This can be achieved by creating awareness regarding the disease and importance of seeking early medical attention.

Strabismus causes cosmetic problem by affecting the normal appearance that has psychosocial impact (social phobia, anxiety) on children and their parents. So, the quality of life gets affected¹⁰⁻¹². Ignorance and illiteracy are the main factors for delay in seeking medical attention and higher incidence of strabismus in our country¹⁰.

MATERIALS AND METHODS

It was a cross-sectional, observational, hospital-based study conducted between February, 2020 - January, 2021 to estimate the prevalence of different types of childhood strabismus and determine the factors associated with strabismus. Children <18 years of age having strabismus were recruited from

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Ophthalmology OPD of a tertiary care hospital of West Bengal, India. Institute ethics approval was obtained and informed consent from legally acceptable representative was taken from all recruited study subjects. The data were collected in a predesigned pretested proforma. Patients having pseudostrabismus, unco-operative patients and those unwilling to give informed consent were excluded from the study. A total number of 96 patients participated in the study. All the eligible patients were recruited serially throughout the duration of the study.

Visual acuity test, refraction test with cycloplegic, slit lamp examination and fundus examination was performed for all the participants.

Visual Acuity (VA) was assessed by using fixation preference test, Teller's acuity cards, pictorial vision charts, visual evoked potential (VEP) in <3 years children; Tumbling E chart for 3-5 years children and Snellen's chart for 5 – <18 years old children. Visual acuity in <3 years old children were classified as good & poor vision; VA in children 3 – <18 years were classified into four groups. Group1: having VA 6/6, Group 2: VA 6/9-6/18, Group 3: VA 6/24-6/60 & Group 4: VA <6/60.

Strabismus evaluation was done by cover-uncover test, prism bar cover test, measurement of deviation and Binocular Single Vision (BSV) with synoptophore, Hirschberg test, modified Krimsky corneal reflex test, diplopia charting with Hess chart, Force Duction Test (FDT). Accommodative Convergence-to-Accommodation (AC/A) ratio was calculated using heterophoria method.

We classified the patients into 4 groups according to age (Group1 : 0-5 years, Group 2 : 5-10 years, Group 3 : 10-15 years & Group 4 : 15 – <18 years).

Amblyopia among children <3 years was detected based on fixation preference. Good fixation or poor fixation by one eye or failure for maintaining fixation for more than 2 seconds when fellow eye was uncovered¹³. Although it may not be a perfect method for diagnosis of amblyopia, it is most widely accepted method now a days for deciding the need for amblyopia treatment in children <3 years with strabismus and/or anisometropia¹³⁻¹⁵.

Modified Kuppaswamy Scale was used for evaluation of socio-economic status, (parameters used: education of the head of the family, occupation of head of family and family income per month)¹⁶. Serological

investigations, Chest X-ray, ECG, CT scan, MRI scan were done when needed.

The data was collected in a case record format and analyzed using SPSS software. P-value <0.05 was considered statistically significant.

RESULTS

During the study period, a total of 5746 patients below 18 years of age attended our OPD with various ophthalmological ailments. Among them 108 patients presented with strabismus. Thus, prevalence of childhood strabismus was estimated to be 1.88%. Applying the exclusion criteria, a total of 96 patients with 192 eyes were included in our study. Majority of the patients were of 5-10 years of age (39.6%). The mean and median age at presentation was 7.5±4.9 (range: 6 months - 17 years) and 7 years respectively. The total number of male (M) patients was 56 (58.3%) and female (F) was 40 (41.7%) with M:F ratio = 1.4:1. Hindus (62.5%) were more in number than Muslims (37.5%). Majority of the patients belonged to lower middle class of socio-economic status (59.4%)(Table 1).

Abnormal head posture was observed in 25% patients; among them face turn was most common (22.9%). Mean angle of deviation was 39.5±17.7 Prism Diopter (PD). In our study population, 84.4% patients had normal gaze. Among the restricted gaze, abduction defect (13.6%) was most common gaze abnormality. AC/A ratio was normal in 93.7% patients and 6.3% had high AC/A ratio (Table 2).

Among children <3 years, 13 (13.5%) patients had good vision and 8 (8.3%) patients had poor vision. In children between 3-<18 years of age, 37 (38.5%) patients had 6/6 best corrected VA (BCVA), 15

Table 1 — Demographic Profile

Characteristics	Number (Percentage)
Age :	
0 - 5 years	34 (35.4%)
5 - 10 years	38 (39.6%)
10 - 15 years	15 (15.6%)
15 - <18 years	9 (9.4%)
Sex :	
Male	56 (58.3%)
Female	40 (41.7%)
Religion :	
Hindu	60 (62.5%)
Muslim	36 (37.5%)
Socio-economic Status :	
Upper	1 (1.0%)
Upper middle	5 (5.2%)
Lower middle	57 (59.4%)
Upper lower	29 (30.2%)
Lower	4 (4.2%)

Table 2 — Strabismus Profile

Characteristics	Number (Percentage)
Head Posture :	
Normal	72 (75%)
Face turn	22 (22.92%)
Head tilt	1 (1.04%)
Chin lift	1 (1.04%)
Laterality of Strabismus :	
Unilateral (right)	31 (32.3%)
Unilateral (left)	38 (39.6%)
Bilateral (alternate)	26 (27.1%)
Bilateral (fixed)	1 (1.0%)
Gaze Restriction :	
No gaze restriction	81(84.4%)
In Abduction	13 (13.6%)
In Adduction	1 (1.0%)
In elevation	1 (1.0%)
Refractive Status :	
Emmetropia	40 (41.7%)
Hypermetropia (with Astigmatism)	2 (2.1%)
Hypermetropia (without Astigmatism)	24 (25%)
Myopia (with Astigmatism)	4 (4.1%)
Myopia (without Astigmatism)	26 (27.1%)
AC/A Ratio :	
Normal	90 (93.7%)
High	6 (6.3%)

(15.6%) patients had 6/9-6/18 BCVA, 8 (8.3%) had BCVA of 6/24-6/60 and 15 (15.6%) had <6/60 BCVA.

Out of 96 cases, 41.7% patients were emmetropic. Most common refractive error was myopia (31.3%) followed by hypermetropia (27.1%). Among the myopic children, exotropia was most common (46.7%); whereas among hyperopic children, esotropia was most commonly found (57.7%). Esotropia (60%) was more common than exotropia (32.5%) among children having emmetropia. Majority of the strabismic children having hypotropia, myopia was most common refractive error (60%).

Concomitant strabismus (85.4%) was more in number than incomitant strabismus (14.6%). Esotropia (55.2%) was the most common variety, followed by exotropia (35.4%), hypotropia (5.2%) and hypertropia (4.2%). Among esotropia variant, we found that sensory esotropia was the most common variety (12.5%). Among exotropia, the most common variety was sensory exotropia (14.6%)(Table 3).

Amblyopia was found in 15.6% of strabismic children. Among them, strabismic amblyopia (8.3%) was the most common type, followed by stimulus deprivation amblyopia (4.2%) and anisometropic amblyopia (3.1%). Strabismic amblyopia was more commonly found among exotropic children. All 3 children of anisometropic amblyopia had esotropia and stimulus

Table 3 — Types of Strabismus

Type of strabismus	Frequency (Percentage)
Esotropia :	
Essential infantile esotropia	4 (4.2%)
Acute concomitant esotropia (ACE)	4 (4.2%)
Refractive normo-accommodative	6 (6.3%)
Refractive hyper-accommodative	2 (2.1%)
Non-refractive hyper-accommodative	4 (4.2%)
Non-refractive hypo-accommodative	8 (8.3%)
Partially accommodative	3 (3.1%)
Sensory esotropia	12 (12.5%)
Paralytic esotropia	
(a) 6 th CN palsy	6 (6.3%)
(b) Myasthenia gravis	1 (1.0%)
Esotropia associated with Nystagmus	
Blockade Syndrome (NBS)	1 (1.0%)
Microtropia	1 (1.0%)
Strabismus fixus (Convergent Variant)	1 (1.0%)
Exotropia :	
Infantile exotropia	12 (12.5%)
Intermittent exotropia	3 (3.1%)
'V' pattern exotropia	1 (1.0%)
Sensory exotropia	14 (14.6%)
Restrictive exotropia	3 (3.1%)
Paralytic exotropia	1 (1.0%)
Hypertropia	4 (4.2%)
Hypotropia	5 (5.2%)
TOTAL	96 (100%)

deprivation amblyopia was also common among esotropic children.

In our study, 25% strabismic patients had no associated factors. Birth asphyxia (13.5%) was the most common factor associated with, followed by Delayed Developmental Milestone (DDM) (12.5%). Both birth asphyxia and DDM was more common among esotropic children. History of SNCU/NICU admission was present in 21.9% patients and 11.3% patients had recent history of (h/o) fever (Table 4).

DISCUSSION

In our study, males (58.3%) were more commonly affected with M : F ratio 1.4 : 1. Males had greater mean age at presentation (7 years 3 months) than females (6 years 10 months), which was contrary to the study conducted by Choudhry TA, *et al*¹⁷. Hindus (62.5%) were more in number than Muslims (37.5%) in the present study. Majority of the patients belonged to the lower middle socioeconomic class (59.4%), followed by upper lower class (30.2%). This lower socioeconomic status might be responsible for unawareness of disease, delayed presentation and late treatment.

In our study, comitant strabismus was more common

Table 4 — Factors associated with Strabismus

Associated factors	Frequency (Percentage)
No associated factors	24 (25%)
Family history	4 (4.2%)
Consanguineous marriage	1 (1.0%)
Birth asphyxia (with SNCU/NICU admission)	13 (13.5%)
Birth trauma	6 (6.3%)
Low birth weight (with SNCU/NICU admission)	6 (6.3%)
Delayed Developmental Milestone (DDM)	12 (12.5%)
Prematurity (with SNCU/NICU admission)	2 (2.1%)
Seizure disorders	5 (5.2%)
Neonatal sepsis	1 (1.0%)
Neonatal jaundice	1 (1.0%)
Recent history of fever	
With meningitis	7 (7.3%)
Without meningitis	4 (4.2%)
Maternal illness during antenatal period	2 (2.1%)
h/o long term topical steroid use	1 (1.0%)
Hypoxic Ischemic Encephalopathy (HIE)	3 (3.1%)
Thyroid Ophthalmopathy	1 (1.0%)
Arachnoid Cyst	1 (1.0%)
Cranial Synostosis	1 (1.0%)
Myasthenia gravis	1 (1.0%)
TOTAL	96 (100%)

than incomitant strabismus. Esotropia (55.2%) was the most common variety of strabismus. Similar result was found in the study conducted by Robaei D, *et al* (2006) and Mohny BG, *et al* (2007)^{6,18}. But, exotropia was more common than esotropia variant among comitant horizontal strabismus in a study by Chia A, *et al*¹⁹.

Among esotropia variant, sensory esotropia (12.5%) was the most common variety. This result was contrary to the study by Mohny BG, *et al* where the most common type was accommodative esotropia¹⁸. In another study by Greenberg AE, *et al*, fully accommodative esotropia was most frequent type²⁰. Among exotropia variant, the most common variety was sensory exotropia (14.6%) in our study, whereas in a study by Govindan M, *et al*, intermittent exotropia and convergence insufficiency was the most frequent type of exotropia²¹.

The underlying causes of sensory esotropia were congenital/developmental cataract and retinoblastoma. The causes of sensory exotropia were congenital/developmental cataract, traumatic cataract, complicated (uvitic) cataract, retinal detachment, Persistent Hyperplastic Primary Vitreous (PHPV), retinoblastoma, unilateral pathological myopia, ocular cysticercosis and secondary optic atrophy.

In our study 4.2% patients had acute Acquired Comitant Esotropia (ACES) and their mean age at

presentation was 4.5 years and most of the children had history of recent onset fever. In a study by Buch H, *et al*, the mean age of presentation was 4.7 years among ACES patients²². Hypertropia was 4.2 % in our study sample. Whereas low prevalence of hypertropia (approximately 0.26%) was found in the study by Tollefson, *et al*²³.

Abnormal head posture like face turn (22.9%) was seen in paralytic strabismus (due to 6th cranial nerve palsy), acute comitant esotropia, A-V pattern strabismus, nystagmus cases with a null position and restrictive strabismus.

Visual acuity assessment was challenging in preschool children (<3 years) & children having mental retardation/ Cerebral Palsy (CP). Decreased vision in strabismic children were due to anisometropia, amblyopia or organic causes (congenital/traumatic cataract, retinal detachment, retinoblastoma, long standing papilledema, optic atrophy and ocular cysticercosis).

In our study, myopia (31.2%) was the most common refractive error among the strabismic children. Similar result was found in a study done by Han KE, *et al*¹ whereas in a north Indian study done by Singh A, *et al*, hypermetropia was the most common refractive error among strabismic children²⁴. In present study, myopia was more common among exotropia, whereas hypertropia was more common among esotropia. Prolonged suboptimal convergence for near vision and blurred distant vision in myopes may cause breakdown of fusional control and subsequent exotropia development.

Abduction defect (13.6%) was the most common defect of extraocular muscle movement, which was due to 6th cranial nerve palsy, restriction of movement by tumor or thickened muscles due to thyroid ophthalmopathy. Adduction defect (1.0%) was due to 3rd cranial nerve palsy; and elevation defect (1.0%) was due to congenital superior rectus palsy.

Few strabismic children had systemic associations of Hypoxic Ischemic Encephalopathy (HIE) (3.1%), craniofacial dysostosis (1.0%) and arachnoid cysts (1.0%). These systemic associations suggest that neurological insult at the cerebral level might be responsible for strabismus. Further studies are needed to rule out the exact cause of association.

In the present study, strabismic amblyopia (8.3%) was the most common type of amblyopia and was most

commonly found among exotropic children. Anisometropic amblyopia was most commonly found among esotropic children. Whereas in a study by Chen X, *et al* among 36-72 months aged children in eastern China, anisometropic amblyopia was the most common type of amblyopia and amblyopia was most common among comitant esotropia group²⁵. Anisometropic amblyopia was also the most common form of amblyopia among children of untreated infantile esotropia in a study by Calcutt C²⁶.

In the present study, birth asphyxia (13.5%) was the most common factors associated with strabismic children. Family history of strabismus was most commonly found among hyperopic exotropia group in our study, whereas Ziakas NG, *et al* found that family history of strabismus was more common in hypermetropic accommodative esotropia group²⁷. Prematurity (2.1%) was more common among children having esotropia than exotropia. This result is similar to the previous published literature²⁸. Prematurity and birth asphyxia may cause maldevelopment of central oculomotor control.

Positive family history of squint was more common among children having esotropia, which was contrary to the prior reported literature^{1,28}. History of parenteral consanguinity was found among strabismic children in our study (1.0%). There was significant association found between consanguineous marriage and development of strabismus in studies conducted by Bagheri M and Doctor MB^{9,28}. This suggests that inheritance play important role in development of strabismus. Hence early screening and counselling may play important role among partners of consanguineous marriages.

We have found 5.2% strabismic children had history of seizure disorders. This association between seizure and strabismus may be due to impairment of normal cortical development and ocular fusion²⁹.

CONCLUSION

Strabismus is a common treatable cause of ocular morbidity in children. Untreated strabismus left for long period may result in Binocular Single Vision (BSV) defect, amblyopia and psychosocial impact on children. Hence early detection and treatment is important. This can be done by creating awareness among the parents regarding the disease and importance of early presentation and treatment. Very few studies on clinical profile of strabismus among

children have been conducted in this region. Our study may help in estimation of magnitude of problem, planning for early detection and management strategies for this potentially treatable ocular morbidity.

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