

# Burden of Ocular Motility Disorders at a Tertiary Care Institution: A Case to Enhance Secondary Level Eye Care

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## ABSTRACT

**Aim:** To evaluate the profile of strabismus and amblyopia in patients presenting to a tertiary care institution in order to understand the disease burden. **Materials and Methods:** A retrospective, prospective hospital-based observational study was conducted at a tertiary level eye care hospital in India. All patients with strabismus or amblyopia who presented over a 1-year period were identified and referred to the squint clinic, where they were evaluated with a detailed clinical history and examination. **Results:** A total of 24475 patients were evaluated, of which 1950 had strabismus or amblyopia. The overall magnitude of amblyopia and strabismus was 2.0% [95% confidence interval (CI), 1.8-2.2]) and 6.9% (95% CI, 6.6-7.2), respectively. About 20% of those seeking an ophthalmic consultation were children and they constituted over half of the population referred to the squint clinic. Among younger children, the burden of amblyopia and strabismus was 84.4% and 26.6%, respectively. Among the referred patients, strabismus was noted in 84.6% ( $N = 1649$ ), most of the cases of which was of the comitant subtype (78.1%,  $N = 1288$ ) with an equal distribution of exotropia and esotropia. Paralytic [12.9% ( $N = 251$ )] and restrictive [4.7% ( $N = 85$ )] squint constituted the remaining burden of strabismus. **Conclusion:** Strabismus and amblyopia affect a sizeable proportion of patients presenting to a tertiary care ophthalmology setup. A significantly higher burden is present in the pediatric population. The majority of the cases of strabismus are of a comitant variety, which do not merit tertiary level eye care. There is a need to improve pediatric eye care at a secondary level to reduce the immense burden on tertiary referral centers.

**Keywords:** Amblyopia, esotropia, exotropia, ophthalmology, pediatric, strabismus

## Introduction

Strabismus (squint) and amblyopia are not infrequent causes of ocular morbidity in India. Both typically affect children in the early years and subsequently result in vision loss and impaired binocular function.<sup>(1)</sup> While these have not been disorders under the spotlight

of India's national program for control of blindness, they have been given due attention in the recent thrust on pediatric ophthalmology in the Vision 2020 initiative.

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While the literature abounds in studies discussing the prevalence of amblyopia and strabismus, both globally and in India, there are few hospital-based studies that provide the complete clinicodemographic profile of amblyopia and strabismus, including their subtypes. The current study evaluates all patients who visited a tertiary care center, in an attempt to better define the clinical and demographic pattern of strabismus across all ages in the Indian scenario while aiming to highlight the immense load of this condition on a tertiary level eye care center.

## Materials and Methods

A prospective, retrospective hospital-based observational study was conducted at a tertiary level eye care center in India after prior approval from the institution's Ethics Committee. All patients presenting to the ophthalmic outpatient department over a 1-year period (February 1, 2012 to January, 31 2013) underwent a screening examination for ocular motility or related disorders. The protocol for examination for all patients who were evaluated at the general outpatient clinic included a visual acuity assessment, cover test, ocular motility examination, slit lamp examination, and fundus examination. If on initial examination there was a suspicion of amblyopia or strabismus, the patients were referred to the squint and amblyopia clinic. At the clinic, the patients underwent a detailed evaluation by an expert ophthalmologist. The clinic workup included recording a detailed clinical history including age of onset, duration of symptoms, progression of symptoms, and previous treatment taken, along with a comprehensive eye examination. The examination included monocular distance visual acuity, evaluation of ocular motility and alignment, anterior segment examination, and fundus evaluation. Age-appropriate cycloplegic refraction was done to assess the refractive status of the eyes. The cycloplegia of choice for assessing refractive status was atropine 1% ointment for children aged  $\leq 5$  years and homatropine 2% eyedrops for subjects aged above 5 years.

Strabismus or squint was defined as the presence of misalignment between the visual axis of the eyes (as evidenced by a cover test) presenting with deviation of the eyes. Strabismus was further subdivided into comitant (if the amount of misalignment between the eyes due to squint remained equal in all directions of gaze) and incomitant (if the amount of misalignment between the eyes due to squint varied in different directions of gaze). If the squinting eye was deviated inward, it was termed as a convergent squint or esotropia and if the squinting eye was deviated outward, it was termed as a divergent squint or exotropia. Nystagmus was defined as the presence of involuntary wriggly or dancing eye movements. Amblyopia was defined as reduced vision

in either or both eyes in the absence of an organic cause. Amblyopia was classified as anisometropic if there was a significant difference between the refractive error of the two eyes, or strabismic if the amblyopia was caused due to squint.

Unilateral amblyopia was diagnosed on the basis of difference in best corrected visual acuity of two lines or more between the two eyes in the absence of any organic cause and best corrected visual acuity in the worse eye being  $<20/30$ . Any predisposing factor such as anisometropia or strabismus was noted. Bilateral amblyopia was defined as bilateral decreased best corrected visual acuity  $<20/30$  (or equivalent) in the presence of bilateral isometropia (hyperopia  $\geq 4.00$  D, myopia  $\geq 6.00$  D, astigmatism  $\geq 2.50$  D).

Ocular alignment was evaluated using unilateral cover (cover-uncover) test, simultaneous prism and cover test at 6 m (with 20/30 optotype of the Snellen chart for fixation) and at 40 cm (with near N9 target for fixation), with and without optical correction. For measurement of squint, the prism bar cover test was applied in patients with both eye vision  $\geq 20/30$  having central fixation; the Krimsky test was used in patients with low vision in one eye ( $<20/200$ ); and the Hirschberg test was used in young children, patients with bilateral poor vision, or uncooperative patients. Strabismus was further classified as manifest or latent squint. Manifest strabismus was further divided into comitant (labeled as esotropia or exotropia) and incomitant (labeled as paralytic or restrictive squint). Manifest horizontal strabismus was also classified as intermittent and constant. The presence of nystagmus was noted, as was its association with squint or amblyopia.

Statistical analysis was done using Stata 11.0 (StataCorp LP, College Station, Texas, USA). The proportion was estimated by dividing the number of individuals with any type of strabismus or any form of amblyopia by the total number of individuals recruited. Exact binomial confidence intervals (CIs) were calculated for the proportion estimates. The results were reported as proportion (95% CIs). Descriptive statistics were used to depict the subclassification of strabismus and amblyopia.

## Results

A total of 24475 patients visited the eye hospital during the year for recruitment in the study and were considered the study population. Of these, 1950 patients were diagnosed to have either squint or amblyopia and were referred to the squint and amblyopia clinic [Table 1]. Mean age of these 1950 patients was  $16.1 \pm 14$  years. Around one in four

**Table 1: Demographic and clinical profile of study subjects**

Parameters		Overall (N = 24475) Number (%)	Squint clinic referrals (N = 1950) Number/Population (Percentage; 95% CI)
Age	<12 years	4805 (19.6)	1204/4805
	≥12 years	19670 (80.4)	(25%; 23.8-26.3) 926/19670 (4.7%; 4.4-5.0)
Sex (among ≥12 years; N=19670)	Male	12971 (52.9)	632/12971
	Female	6699 (27.3)	(4.8%; 4.5-5.2) 294/6699 (4.3%; 3.9-4.9)
Strabismus			
All		1649 (6)	1649/24475
Comitant		1288 (5.0)	(6.8%; 6.6-7.2)
Incomitant		361 (1.4)	1288/1649 (78.1%; 76.0-80.0) 361/1649 (21.8%; 19.9-23.9)
Comitant	Esotropia	598 (2.4)	598/1288
	Exotropia	587 (2.3)	(46.4%; 43.6-49.1)
	A-V pattern	103 (0.4)	587/1288 (45.5%; 42.8-48.3) 103/1288 (7.9%; 6.5-9.6)
Esotropia (Comitant)	Intermittent	8 (0.03)	8/598
	Constant	590 (2.4)	(1.3%; 0.5-2.6) 590/598 (98.6%; 97.3-99.4)
Exotropia (Comitant)	Intermittent	184 (0.7)	184/587
	Constant	403 (2)	(31.3%; 27.6-35.2) 403/587 (68.7%; 64.9-72.5)
Incomitant	Paralytic	276 (1.1)	276/361
	Restrictive	85 (0.3)	(76.4%; 71.7-80.7) 85/361 (23.6%; 19.2-28.2)
Strabismus magnitude (Distance) (N = 1649)			
1-9 PD			905
10-30 PD			471 (28.6%; 26.4-30.9)
>30 PD			273
Strabismus magnitude (Near) (N = 1649)			
1-9 PD			880
10-30 PD			440
>30 PD			329
Amblyopia			
All		494 (2)	494/494
Anisometropic		174 (0.7)	(2.0%; 1.8-2.2)
Strabismic		320 (1)	174 320/494 (64.7%; 60.3-68.9)
Nystagmus		224 (0.9%)	

children from the total population suffered from either strabismus or amblyopia and were referred to the squint clinic as against 4.7% of the adults. Among the adults, the male-to-female ratio in the main population was 2:1, with an equitable proportion of adult males and females being referred from the total population. Ocular motility-related morbidity was noted in 4.8% of the males and 4.3% of the females who visited the hospital outpatient department.

Overall, the magnitude of strabismus was found to be 6.9% [95% confidence interval (CI), 6.6-7.2%], with that in children (age <12 years) being higher, at 14.8% (95% CI, 6.6-15.7%). Of the total number of referred cases, 84.6% (N = 1649) had squint, of which over three-fourth were of the comitant subtype. Of the comitant squints, 103 cases had a significant difference between up gaze and down gaze measurements and were classified separately as pattern strabismus. For the remaining 1185, there was an equal distribution of exotropia and esotropia. Among all squints, paralytic squints constituted 14.2% (N = 276), while restrictive squint constituted 4.3% (N = 85). Of the patients unaccounted for in the strabismus or amblyopia groups, 5.9% (N = 111) had phorias, 1% had vertical squints (N = 20), and 2.9% (N = 57) were wrong referrals.

Strabismic amblyopia was the most common type of amblyopia noted in the study and was nearly equally distributed among esotropia and exotropia. Of the children (aged 6 years and below) who visited the eye hospital, 84.4% and 26.6% had amblyopia and strabismus, respectively.

Nystagmus was noted in 11.5% (N = 224). Nystagmus was associated with comitant strabismus in 7% (N = 136), with amblyopia in 3% (N = 61) and with incomitant squint in 0.6% (N = 11). The table describes in detail the magnitude of strabismus and amblyopia and includes subgroup analysis.

## Discussion

The study examined the clinical and demographic profile of patients visiting the outpatient department and squint clinic of a tertiary level eye care institution in India.

Amblyopia was found in over 2% of the patients seeking an eye consultation. This value is similar to the general prevalence rates of amblyopia described in the literature, which vary 0.2-5.3%, with slightly higher figures in India.<sup>(2-4)</sup> While it appears not to form an important reason for patients to visit a tertiary care eye hospital, it has been estimated to be the cause for 12.3% of cases of severe visual impairment in India.<sup>(5-7)</sup> The scenario changes in the pediatric subgroup where, of the nearly 5,000 children aged 12 years and below, over 60% had amblyopia, while in the age group of 6 years and below, nearly 85% suffered from amblyopia. This is significantly more than that observed in the general pediatric population, where the prevalence of amblyopia in these age groups hovers around 1%.<sup>(8-14)</sup> This a clear indicator of the funneling of pediatric cases to a tertiary care center due to the lack of pediatric eye care facilities at a primary or even secondary level. There are no similar hospital-based studies; therefore a comparison has been made with population-based

studies while recognizing the potential Berksonian bias. The most common type of amblyopia in the current study was strabismic, which has been documented in the literature previously, including in one previous hospital-based study by the authors.<sup>(1,9,10)</sup> In contrast, however, various other studies quote anisometropic amblyopia to be the commoner cause.<sup>(11-14)</sup> There was no category of mixed amblyopia included in our study, and cases of amblyopia having both anisometropic and strabismic components were classified under strabismic amblyopia. The difference in the type of amblyopia observed in population-based studies and hospital-based studies may be explained by the fact that a large number of anisometropic amblyopes in the population may not be seeking consultation at a tertiary level hospital, either due to unawareness of their amblyopia or because they are undergoing management at a secondary level institution. In contrast, amblyopia associated with strabismus is probably more evident and causes the patient to visit a tertiary level hospital. Amblyopia can be easily managed at primary or secondary level clinics and does not routinely require a tertiary level referral. The prolonged follow-up required for amblyopia therapy and the risk of long-term recurrence mandate repeated visits to a tertiary care center, which implies a financial burden to the patient's family. Therefore, developing decentralized pediatric and ophthalmic health care would go a long way in managing diseases such as amblyopia, which have a simple treatment process.<sup>(15)</sup>

The magnitude of squints among all patients seeking an ophthalmology consultation at our institution was 6% and that for children was 26.6%. While there are no previous hospital-based studies that may be compared, population-based surveys among children demonstrate a wide range of prevalence of strabismus varying from 0.29% to 5%.<sup>(8,12,16-19)</sup> This again indicates the excessive referral of pediatric strabismus to a tertiary care institution due to lack of adequate facilities for management at a primary or secondary level. Further, the fact that the large majority of squints seen in the study were comitant squints with a predominant horizontal misalignment, which can easily be managed by a nonspecialist ophthalmologist, only reiterates the need for better infrastructure and skill training at the secondary health care institutions. Such a process would enable tertiary institutions to manage the more complicated cases requiring specialists' intervention. The need for developing more pediatric ophthalmology setups and training ophthalmologists for handling such cases in developing countries including India is further emphasized by the fact that children account for over half (52.5%) of the total patients seen in our squint and amblyopia clinic.

The clinical profile of strabismus demonstrated an equal distribution of esotropia and exotropia.

Hospital-based literature from around the globe differs from this in showing a higher proportion of esotropia than exotropia.<sup>(20-23)</sup> However, these hospital-based studies have only evaluated surgical cases, unlike our study, which evaluated patients with all forms of squint. The majority of the population-based studies in the literature that were conducted among the general population, specifically in the pediatric age group, have demonstrated a higher proportion of esotropia in comparison to exotropia.<sup>(2,20,23)</sup> However, the Baltimore Pediatric Eye Disease Study (BPEDS) showed a near equal distribution of esotropia and exotropia.<sup>(19)</sup> In our study, comitant squints were more commonly associated with younger patients, while incomitant squints occurred predominantly in the older patients. The probable explanation is that the older age group has more risk factors for paralytic squints and restrictive strabismus, including diabetes, hypertension, and thyroid disease, while children have a higher prevalence of refractive and accommodative squints. While the trend is understandable, it has not been categorically documented previously in the literature.

The exact magnitude of nystagmus is still unknown due to paucity of studies. Previous hospital-based data have found a magnitude of 0.24% as against the higher proportion of 0.9% seen in our study.<sup>(24)</sup> It is possible that the scarcity of specialized ophthalmic services at the secondary level have led to a higher referral rate to a tertiary care hospital in India, as evidenced by the relatively higher proportion seen.

A limitation that merits mention is that a significant portion of the study was retrospective and the occasional incomplete or missing records could potentially add errors to the magnitudes reported.

The study has revealed a definite heavy burden of ocular motility morbidity at a tertiary care center. There is a significant financial and socioeconomic burden on society for developing and managing tertiary health care infrastructures, and on individuals for obtaining treatment at such institutions. This has been highlighted in various reports and holds true with regard to the ocular motility disorder burden, too.<sup>(25)</sup> There is a need to manage these cases at secondary level centers and establish proper referral systems so that health care services at tertiary centers are not overburdened.<sup>(26)</sup>

## Conclusion

In conclusion, while defining the clinical and demographic characteristics of patients with strabismus or amblyopia

attending the outpatient department of a tertiary level eye care center, the study sheds light on the fairly heavy pediatric referral and emphasizes the need for better pediatric ophthalmology management at a secondary care level in the country.

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### Conflicts of interest

There are no conflicts of interest.

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