

Prevalence and Pattern of Strabismus in Primary School Pupils in Benin City, Nigeria

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ABSTRACT

Background: Strabismus is the most common amblyogenic factor and approximately 40% of children with manifest strabismus have amblyopia. In Nigeria, it is generally believed that strabismus is not common. However, few studies have been done to determine the prevalence of strabismus in Benin City, Edo State. **Objective:** This study aims to determine the prevalence and pattern of tropias and phorias in primary school children in Benin City. **Methods:** This was a cross-sectional study carried out on primary school pupils in government schools located within Egor Local Government Council Area, Edo State. **Results:** Two thousand one hundred and thirty-nine students (2139) were examined. There were 1024 males (47.87%) and 1115 females (52.13%). The overall prevalence of tropias in this study was 0.89%. Esotropia was seen in 0.56% (12 pupils, SE 0.03%) and exotropia in 0.33% (7 pupils, SE 0.02%) of the pupils. Infantile esotropia was the most common form of esotropia while alternating exotropia was the most common pattern of exotropia. 57.04% of the pupils had heterophoria. **Conclusion:** The prevalence of manifest strabismus in Benin City was low however there should be training of non-ophthalmic staff such as teachers to detect and refer cases of strabismus.

Keywords: Children, Nigeria, pattern, prevalence, pupils, strabismus

INTRODUCTION

Strabismus is the medical term for an eye condition commonly called by various names: Squint, eye turns, crossed eyes, wall-eyes, wandering eyes, swivel eyes, goggle eyes and deviating eyes.^[1] In local colloquial language it is known as “half past four eyes.” Worldwide prevalence of strabismus in the general population is about 3-5%^[2], but studies in Africa show that the prevalence of strabismus among Africans is quite low compared to Caucasian or Asian studies.^[3-11]

Apart from strabismus making a child look different amongst his or her peers, it can also cause vision

threatening consequence known as amblyopia. Strabismus is the most common amblyogenic factor and approximately 40% of children with manifest strabismus have amblyopia.^[12] Children with strabismus and/or amblyopia will lack the ability to fully develop binocular single vision if left untreated and may have an impaired reading performance when the child starts school.^[13] They may have psychosocial difficulties later in life, and this may preclude such individual from particular occupations such as pilot, armed forces, micro chip technologist or becoming an ophthalmologist who performs microsurgical procedures for which binocular single vision is required. Early detection and initiation of treatment are therefore critical in preventing permanent visual impairment.

In Nigeria, it is generally believed that strabismus is not common. However, there is a paucity of studies that actually aim to determine the prevalence of strabismus in Nigerians. The majority of previous studies did not focus primarily on strabismus, so the exact magnitude of the problem may have been underestimated.

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This study aims to determine the prevalence and pattern of tropias and phorias in primary school children in Benin City.

MATERIALS AND METHODS

This was a cross-sectional study carried out on primary school pupils in government schools located in Egor Local Government Council Area within a 12 months period. Egor Local Government Area (LGA) is located within Benin metropolis in Edo state, which is one of the six states of the South-South geo-political zone in Nigeria. It has a population of three hundred and thirty-nine thousand, eight hundred and ninety-nine people (399,899) of the 3.21 million people in Edo state.^[14] The list of all the 50 government primary schools and their student population was obtained from the education authority of the Local Government Council. The schools were divided into five groups based on their location within the five major districts and using a simple random sampling technique by balloting, two schools were selected from each district making a total of ten schools.

Sample size determination: The minimum sample size with 95% confidence limit was determined using the following formula.^[15]

$$n = \left(\frac{z^2 \cdot p \cdot q}{d^2} \right)$$

where, n , the desired sample size, z , the standard normal deviate (1.96), p , a prevalence of 2.4% was chosen based on a previous study on secondary school students with strabismus in Benin City which was 2.4%.^[13]

$$q = 1 - p$$

d , degree of accuracy desired. The degree of precision was set at $P/3$ (0.008) because the prevalence was less than 10% making it a rare disease.^[15]

$$n = 1406.$$

Non-response rate of 80% was adjusted using $n/0.8 = 1757$.

Systematic random sampling technique was used to select every second child from the attendance register in each class.

Approval was obtained from the Ethical Committee of the University of Benin Teaching Hospital and the education authority of Egor Local Government Council. All head teachers of the selected schools were informed of the proposed study and consent forms were given to children who required screening to obtain consent from their parents/guardians.

A researcher administered questionnaire was used in obtaining information on sociodemographic, relevant information regarding birth history, age at onset of squint, history of previous trauma, previous eye surgery and/or eye patching and family history of squint was obtained from either parent/guardian via interviews or written notes/reported speech via their children/wards.

Visual acuity (VA) was tested with Snellen acuity chart while picture acuity chart or the H-O-T-V cards was used to determine the VA for pupils who expressed difficulty with the Snellen chart. Pin hole testing was done for pupils with VA of 6/9 and below. An improvement in VA was taken to indicate a probable refractive error while non-improvement suggested an organic cause or amblyopia. Single letters optotypes were now presented at the same distance.

Hirschberg's test (corneal light reflex) was done for all pupils using a pen torch at near and distant vision to detect cases of manifest strabismus. For pupils with manifest strabismus, Krimsky's test was done to measure the dioptric power of the strabismus.

Cover and uncover tests were done to determine the presence of tropias and phorias in all the pupils. The Maddox wing test was done to reveal the type and the amount in prism diopters of the phoria present at near while the Maddox rod was used to measure the prism diopters of heterophoria at distance.

NPC (Near Point of Convergence) was measured using a 30 cm plastic meter ruler placed on the bridge of the nose with the zero gradation closest to the nose. The target object which was the tip of a pencil was gradually advanced toward the eyes with the child fixating on the target object and asked to indicate when the object became double and this distance was read off the ruler. NPA was also measured with a meter rule as described above but the child was asked to indicate when the target object became blurred and this point was read off the ruler.

An anterior segment examination was done using a pen torch and a non-dilated funduscopy was done using the Keelers ophthalmoscope (specialist). For those with strabismus or decreased VA not improved with refraction, detailed ocular examination with dilated funduscopy was done. Cycloplegic refraction was done with 1% tropicamide for pupils with VA less than 6/9 or below.

Operational definitions

Hypermetropia, myopia and astigmatism were defined as described in previous literature.^[9]

Definitions for accommodative esotropia (refractive and non-refractive), convergence excess esotropia, divergence insufficiency esotropia and consecutive esotropia were as defined in other text.^[16,17]

Congenital exotropia: Large angle of deviation ($\geq 30\Delta$) noticed shortly after birth with alternating fixation and normal refraction for age.

Sensory exotropia, convergence weakness exotropia, divergence excess exotropia were as defined in other literature.^[17]

Statistical analysis

Data obtained were analyzed by computer using the Instat GraphPad[™] version 2.05a software. Frequencies, means, standard deviations, prevalence rates and standard errors were determined, while tests for statistical significance were done by Chi-square analysis and Fisher's exact test.

RESULTS

Two thousand two hundred and ninety-four (2294) pupils were selected for screening but 2139 were completely examined representing a participation rate of 93.24%. There were 1024 males (47.87) % and 1115 females (52.13%) with a male: female ratio of 1:1.09. The age range was from 5 to 19 years with a mean age of 10.10 years \pm SD 2.03. The age and sex distribution of students is shown in Figure 1.

Prevalence and pattern of tropia

The overall prevalence of tropias in this study was 0.89%. Esotropia was more common than exotropia. Females were more affected but this was not statistically significant; P value = 1.000 [Table 1].

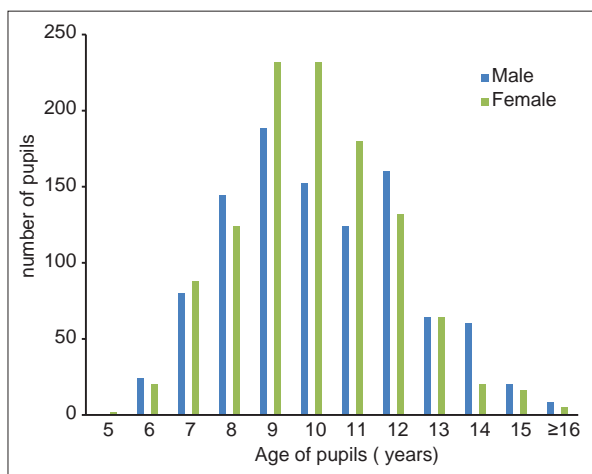


Figure 1: The age and sex distribution of the pupils

Pattern of esotropia

Infantile esotropia was the most common form of esotropia (41.6%) found in this study. The degree of esotropia seen was 7 in 2 cases, 15 in 2 cases, 30 in 5 cases and 45 in 2 cases [Table 2].

Pattern of exotropia

Alternating exotropia was the most common pattern of exotropia (71.4%) seen in this study. The degrees of exotropia were about 30 in 3 cases and 45 in 2 cases [Table 3].

Pattern and prevalence of phoria

The overall prevalence of heterophoria among primary school pupils in Egor LGA was found to be 57.04% (SE 1.15%) in this study. The prevalence of heterophoria at near was 23% (SE 0.83%) while heterophoria at distance was 53.62% (SE 1.16%). Table 4 shows the pattern and prevalence of heterophoria at near and distance [Table 4].

Exophoria at near was more prevalent (12.16%) than esophoria at near (10.84%). Phoria at near was found to occur more in males than females and this difference was found to be statistically significant, $\chi^2 = 6.79$, P value = 0.009. There was no case of hyperphoria or cyclophoria. The degrees of esophoria at near ranged from 3 to 11 prism diopters while the degrees of exophoria at near ranged from 2 to 16 prism diopters.

Refractive errors were present in 142 pupils (6.64%) of the pupils. Of these, 53 (37.32%) had a phoria at near. The presence of a refractive error significantly increased the chance of having a phoria at near, $P = 0.01$, $\chi^2 = 5.44$.

Table 1: Pattern and prevalence of tropias among pupils in Egor LGA

Type	Male (%)	Female (%)	Total (%)	Male: Female ratio	Prevalence (%)
Esotropia	5 (26)	7 (37)	12 (63)	1:1.4	0.56
Exotropia	3 (16)	4 (21)	7 (37)	1:1.33	0.33
Total	8 (42)	11 (58)	19 (100)	1:1.38	0.89

Using Fisher's exact test P value = 1.000 (95% confidence interval 0.1444-6.283). LGA: Local government area

Table 2: The types of esotropia among pupils in Egor LGA

Type of esotropia	Male	Female	Total	Percentage
Infantile	3	2	5	41.6
Accommodative	1	2	3	25
Convergence excess	0	2	2	16.7
Divergence insufficiency (A-pattern)	1	1	2	16.7
Total	5	7	12	100

LGA: Local government area

Table 3: Pattern of exotropia among pupils in Egor LGA

Type of exotropia	Male	Female	Total	Percentage
Alternating	2	3	5	71.4
Sensory	1	1	2	28.6
Total	3	4	7	100

LGA: Local government area

Table 4: Patterns and prevalence of heterophoria at near and distance

Phoria	Male	Female	Total	Male: Female	Prevalence (%)
Esophoria at near	144	88	232	1.64:1	10.84
Exophoria at near	131	129	260	1:1	12.16
Esophoria at distance	282	385	667	1:1.36	31.18
Exophoria at distance	247	233	480	1:0.94	22.44

The prevalence of heterophoria at distance was 53.62%. Esophoria at distance (31.18%) was more prevalent than exophoria at distance. Phoria at distance was found to be more common in females than males with a male: female ratio of 1:1.7 and this was statistically significant, $\chi^2 = 9.47$, $P = 0.002$. There was however a slight reversal in sexes with exophoria at distance with a male: female ratio of 1:0.94. The degree of esophoria at distance ranged from 3 to 9 prism diopters while exophoria ranged from 2 to 12 prism diopters.

128 pupils (90.14%) with refractive error had a phoria at distance however the presence of a refractive error did not significantly increase the chance of having a phoria at distance, χ^2 value = 0.07433, P value = 0.7851.

DISCUSSION

There was a fairly equal distribution of male and females in the pupils examined. This shows a fairly equal school enrollment of boys and girls which may be as a result of enhanced public enlightenment campaign regarding the benefits of girl child education. Majority of pupils screened in this study fell between the ages of 8 and 12 years. This is not unusual as the average primary school entry age is 5-6 years and given 6 years allotted for primary education, school leaving age is about 10-12 years.

The prevalence of tropias found in this study was lower than the global prevalence of 3-5%^[2] but similar to previous Nigerian and African studies.^[4,10,11,18] This further confirms the low prevalence of strabismus among Negroes.^[3] This prevalence was however higher than the prevalence rates of 0.26-0.4%, which were found in studies conducted in Ibadan,^[8] Ilorin,^[7] Ilesa East LGA^[5] and Anambra state.^[6] This prevalence was lower than reported rates among the secondary school students

from Benin City (2.4%)^[13] and Ile-Ife (4.3%).^[5] This observed increase in prevalence among the secondary school students may be as a result of decompensation of children who had phorias to tropias and also an increase in incidence of acquired strabismus as the children grew older. The study in Benin City was also hospital based which are usually skewed and may not necessary represent the prevalence rates in the community.

Studies from other African countries had prevalence rates ranging from 0.2% to 0.5%,^[9-11,18] which was also lower than the prevalence found in this study. This may be due to differences in methodology, the study population or may be a regional difference. Though the prevalence in this study was lower than the rates found from studies in the United Kingdom, United States of America, Brazil, Canada and Seoul,^[19-23] it was similar to a study in Japan which found a prevalence of 0.99% in elementary pupils.^[24] It is believed that the prevalence of strabismus among people of Asian origin and mixed ethnicity is low as compared to white populations.^[25]

Standardization of age in strabismus studies should be similar to the age cut-off of 40 years used in most adult studies. A recommended possible stratification may be birth- 3, 4, 8 and 9-16 years (age at last birthday) based on the anatomic and physiologic maturation of the visual pathway.^[26] This will allow for statistically acceptable comparisons to be made from various studies and any actual increase in strabismus prevalence with the increasing age may be detected.

Pattern of tropia

The most common type of manifest strabismus was esotropia; this is similar to studies in Ilorin,^[7] Ibadan,^[8] Enugu,^[27] Jos,^[28] United Kingdom,^[19] United states of America^[20,29,30] and Canada.^[22] However, studies from Japan,^[24] Hong Kong,^[31] and Brazil^[21] show a preponderance of exotropia.

The reasons for this variability in the pattern of tropias in different regions of the world and from studies in the same country are not fully understood, but several studies have suggested a complex interaction between genetic, racial, anatomic, refractive and environmental factors.^[32] A study^[33] suggested that longer duration and higher intensity of sunlight were associated with higher prevalence of exotropia. This however has not been convincingly proven as results from studies conducted in Jos^[28] and Ilorin,^[7] which are regions in Nigeria with fairly similar sunlight exposure and intensity showed conflicting patterns.

There were more females with tropias than males and this is similar to the findings in Ibadan,^[8] Lagos,^[19]

Enugu,^[27] Ethiopia^[34] and United States of America^[20,29] and like these studies the difference was not statistically significant. Though there were more males than females with tropias in studies in Ilorin,^[7] Kaduna^[4] and Jos,^[28] the difference in gender was also not statistically significant. This finding supports other studies which show that gender plays no role in the etiopathogenesis of strabismus.

Pattern of esotropia

The most common type of esotropia found in this study was infantile esotropia, while accommodative esotropia was the second most common type. This pattern is similar to the findings in Ilorin,^[7] Ibadan^[8] and Enugu.^[27]

Accommodative esotropia was seen in three cases. Some studies have suggested that those with a high AC/A ratio have relatively less hypermetropia^[35] and this was the finding in two cases. The last case had a high degree of hypermetropia in the esotropic eye. The esotropia in this patient may be as a result of the increased amount of convergence associated with accommodation applied to clear the blurred retinal image caused by the high degree of hypermetropia.

Convergence excess esotropia was seen in two cases in this study and is believed to be brought about by the tonic innervation of the extra ocular muscles.^[16] Divergence insufficiency with a pattern was seen in two cases in this study. Oblique muscle dysfunction has been implicated which could be superior oblique muscle over action or under action of the inferior oblique muscle.^[17]

Pattern of exotropia

Exotropia with alternating fixation was the most common form of exotropia seen in this study. A disturbance in the tonic horizontal vergence is usually considered the cause of most primary divergent deviations. This results in either a deficiency of convergence innervations or an excess of divergence innervation.^[16] Secondary anatomic factors probably also play a role, such as lateral rectus muscles hypertrophy and changes in the elastic fibers surrounding the fascial and conjunctival tissues have been observed and may add their force to the divergent pull of the visual axes.^[36] The absence of significant refractive errors seen in this study supposes the above mechanism as a possible cause of the exotropia.

Traumatic immature cataract and macular scar from presumed toxoplasmosis were responsible for the cases of sensory exotropia seen in this study. The disuse of the eye as a result of the poor vision leads to tonic divergence prevailing over tonic convergence and the affected eye becoming exotropic with time.^[16]

Heterophoria

Exophoria at near was more prevalent than esophoria. This was similar to the findings of the Multi-ethnic Pediatric Eye Disease Study Group.^[25] Exophoria is more common in uncorrected myopia but more importantly in young children with astigmatism doing increased near work.^[36] Myopia and myopic astigmatism was seen in 50.33% and this may be responsible for exophoria at near being more prevalent.

Children have a lot of accommodative reserve and the synkinetic relationship between accommodation and convergence may be responsible for the occurrence of esophoria at near.^[36]

Esophoria at distance was more prevalent than exophoria at distance. Esophoria at distance is as a result of divergence weakness while exophoria at distance is as a result of convergence weakness.^[16] Majority of the phorias were less than 10 prism diopters which are usually not clinically significant.^[16]

CONCLUSION

There is a low prevalence of manifest strabismus in our environment compared to Caucasian population. Esotropia was more common than exotropia and heterophoria occurred in more than half of the study population. Though the prevalence of strabismus is low, there should be training of non-ophthalmic staff such as teachers to detect and refer cases of strabismus.

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