Prevalence of Lateral Strabismus in School Children Aged between 5-15 years in Asaba Metropolis, Delta State, Nigeria.

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QR CODE

Doi: https://doi.org/10.21816/ijfmi.v5i1

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ABSTRACT

Strabismus is a state of abnormal alignment of the two eyes which could result in the image of the fixating eye falling on the fovea while the image of the non-fixating eye is focused on an extra-foveal region. The aim of this research isto determine the prevalence of lateral strabismus in school children aged between 5-15years in Asaba metropolis, Delta State, Nigeria. A total of 258 subjects aged between 5-15years (mean age= 10.1±2.3years) were recruited for this study. This comprised of 129 (50%) males and 129 (50%) females (ratio 1:1). The magnitude of tropia (exo – eso) per subject was determined using prism bars and loose prisms. The results showed that of the total 129 male subjects, 4 (1.6%) had esotropia while 1(0.4%) had exotropia. For the female population, of the total 129 females, 5(1.9%) had esotropia while 3 (1.2%) had exotropia. Data obtained from this study were analyzed using descriptive statistics (tables,and pie charts), Chi-square analysis and Statistical Package for Social Sciences (SPSS), version 22.0. The prevalence of strabismus was13(5%) in the study population. Strabismus was also found to be significantly more common with the female gender 8(3.1%) than the male 5 (1.9%). Esotropia was found to be the most dominant type of strabismus 9(3.5%) in the study population. This study strongly recommends that School authorities in developing countries should adopt eye examination as entry level and as well, encourage yearly vision screening for their students and pupils to detect the presence of refractive errors, strabismus and other conditions that can cause strabismus.

Keywords: lateral, strabismus, school, children, Delta, Nigeria.

INTRODUCTION

Strabismus (or squint) is defined as the misalignment of the visual axes where the image of the fixating eye lies on the fovea while the image of the non-fixating eye lies on an extra-foveal region (Fazal, 2012). Sensory strabismus occurs due to vision loss or impairment, leading to horizontal, vertical, or torsional misalignment, or a combination thereof, with the poorer vision drifting slightly over time. Most often, the outcome is horizontal misalignment, and its direction depends on the patient's age at onset of the damage. Patients whose visionsare lost or impaired at birth are more likely to develop esotropia, whereas patients with acquired vision loss or impairment mostly develop exotropia. In extreme cases, complete blindness in one eye generally leads to the blind eye reverting to an anatomical position of rest (Holmes & Clarke, 2006).

In 1827, Anthony White suggested that heterotropia was caused by muscular defects and that a myotomy could correct the deviation. He postulated that the primary cause of heterotropia was a defect in the accommodation–convergence link. Donder's findings were later refuted by Javal (1864) and Worth (1903), who reported that some exo-deviations were associated with hyperopia and eso-deviations with myopia, while others were emmetropic. Their conclusions suggested that the aetiology may be more attributable to a defect in the fusion faculty (Sharima, 2015).

Bruce and Santorelli (2016) conducted a longitudinal study measuring the change in refraction from ages prior to the onset of heterotropia up to a point after development. They found that, in cases of esotropia, children had significant amounts of hyperopia in the deviating eye at the onset, which increased over time. Under normal circumstances, where there is binocular vision (i.e., conjugate movement of both eyes), both eyeballs are coordinated by the brain in all movements. Consequently, the image of whatever one looks at travels through the visual pathway to the visual cortex, where it is interpreted as one (Kushner, 2010). The net effect is an optimum level of vision since both eyes contribute maximally toward the visual process.

The outcome of treatment is dependent on many factors, such as the type of strabismus, age of onset, and visual acuity of each eye. It often involves years of commitment and care. When strabismus is congenital or develops in infancy, it can cause amblyopia, in which the brain ignores input from the deviated eye (Holmes *et al*., 2014). Even with therapy for amblyopia, stereo-blindness may occur. The appearance of strabismus can also be a cosmetic problem. One study reported that 85% of adult strabismus patients had problems with work, school, and sports because of their condition, while 70% said strabismus negatively affected their self-image (Gursoy *et al*., 2012). After surgery, the squint can return, so a second operation is sometimes required to straighten the eyes.

The global prevalence of strabismus has been estimated to range between 3% and 6% (Govindan et al., 2005). In the United States, approximately 3%–5% of children are affected, with about 126,400 new cases occurring each year. The national prevalence of squint in Nigeria is estimated at 5.4%, suggesting that approximately 7.02 million individuals are affected in a population of 130 million (Akpe*et al*., 2014). The prevalence of convergent squint varies across different populations; however, esotropia (ET) is the most common form, constituting roughly half to two-thirds of all misaligned eyes. In the United States, ET is prevalent in 75% of total cases (Pai & Mitchell, 2010). Similarly, in Ireland, ET was found to be five times more common than exotropia (XT) (Durnian*et al*., 2011). However, the prevalence of strabismus differs between races. For instance, a study on preschool children in Ethiopia

found ET to be the most common type of strabismus (Tenkir *et al*., 2010), whereas in Japanese children, XT was more prevalent (Matsuo & Matsuo, 2005). According to the Baltimore Pediatric Eye Disease Study, manifest strabismus was found in 3.3% of white and 2.1% of African American children, with ET and XT each accounting for close to half of all strabismus cases in both groups (Cotter *et al.,* 2011). Questions have been raised as to whether the prevalence of childhood strabismus, particularly in developed countries, is in decline, especially esotropia (Campomames *et al*., 2010).

Therefore, the aim of this study was to determine the prevalence of squint among school children aged 5–15 years in Asaba, Delta State, Nigeria.

MATERIALS AND METHODOLOGY

RESEARCH DESIGN

This was across sectional analytical study which was conducted at 3 centres: Lucid View Eye Clinic, Asaba; Primary Health Centres of Ugbolu, and Oko, all located in Oshimili South Local Government Area, Delta State. The study was carried out from January to July 2019. Questionnaires were also administered to subjects to obtain socio-demographic information. Information obtained from subjects and parents includes the age, sex, school and class, child's birth weight, duration of gestation, and family history of strabismus.

STUDY SAMPLE

The purposive sampling technique was used for this study. All children within this age bracket (5 – 15yrs) who visited the clinic and Primary Health Care centres were questioned and screened. Of the total number of 527 subjects screened during the course of study, 258 subjects who met the inclusion criteria were co-opted for the study. The study sample was made up of subjects aged between 5 – 15years with 129 males and 129 females (ratio 1:1).

DETERMINATION OF SAMPLE SIZE

The sample size was determined using the formula recommended by Fisher *et al.,* (1998) for a population greater than 10,000.

$$n = \frac{z^2 \cdot pq}{d^2}$$

Where:

n= the desired population size, if the population is more than 10,000

z = standard statistics for a 95% level of confidence = (1.96)

p = the proportion of the target population with Squints. 0.8% based on study of Chia *et al.*, (2015).

d = the statistical level of significance set at 0.05 (5%)

q = 1- p

$$n = \frac{(1.96)^2 \times 0.8 \times 0.2}{(0.05)^2}$$

$$= \frac{3.842 \times 0.8 \times 0.2}{0.0025}$$

$$= \frac{0.61472}{0.0025}$$

$$= 245.888$$

$$\simeq 246$$

n = 246.

Considering attrition factor of 5% i.e. 12, n = 258.

3.4 RESEARCH MATERIALS

i. Questionnaires
ii. Examination sheets
iii. Horizontal and vertical prism bars
iv. Occluder
v. Snellen distant and near acuity charts
vi. HOTV chart
vii. Landolt C distance and near charts
viii. LEA distant and near charts
ix. Illuminated N-system near chat
x. Heine Beta200 retinoscope
xi. Auto- refractometre
xii. Keeler monocular direct ophthalmoscope
xiii. Slit lamp biomicroscope
xiv. Trial lens set and frame

METHODS OF DATA COLLECTION

The protocol for examination of subjects who were evaluated includes visual acuity assessment, cover test, ocular alignment examination. Anterior and posterior segment examinations were conducted using the slit lamp biomicroscope and monocular direct ophthalmoscopes respectively.

- Visual acuity testing with the Snellen Eye Chart was done at 6 m distance. Pinhole testing was performed for pupils whose distant VA was 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. 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. Refractive errors were measured with the auto-refractometer and/or the Heine Beta200 retinoscope.
- Ocular alignment was assessed using the Hirschberg light reflex test at a distance of 33 cm, unilateral cover test and cover-uncover test with fixation targets at both 33 cm and 6m.

The recorded data includes: age, gender, type of refractive error, presence of deviation (squint), and conditions associated with squint.

Prevalence was calculated as the ratio of the number of individuals with any type of squint to the total number evaluated.

3.6 INCLUSION CRITERIA

i. Subjects aged between 5-15 years
ii. Subjects with healthy eyes.
iii. Subjects with lateral ocular deviation.
iv. Subjects resident in Asaba metropolis.

EXCLUSION CRITERIA

i. Subjects below 5years or above 15years.
ii. Subjects with unhealthy eyes.
iii. Subjects with binocular vision.
iv. Subjects who are non residents in Asaba metropolis.

ETHICAL CONSIDERATION

i. Ethical approval was obtained from the Delta State Ministry of Education.
ii. Informed consent was obtained from the parents/guardians of the subjects with the willingness of wards to participate.
iii. The study was conducted according to the tenets of the World Medical Association - Helsinki Declaration (1968), as revised (2013).
iv. The records were de-identified and anonymous in accordance with best standard practices.

STATISTICAL ANALYSIS

Data obtained from this study were analyzed using descriptive statistics (tables, and pie chart), Chi-square analysis and Statistical Package for the Social Sciences (SPSS), version 22.0. These enabled the researcher to establish the statistical significance of the relationship between age, as well as gender and distribution of strabismus in the study population.

RESULTS

Table 1 shows the age range and the gender distribution of the study population. A total of two hundred and fifty-eight (n=258) subjects aged between 5-15years (mean age= 10.1±2.3years) participated in this study. The study sample had 129 (50%) males and 129 (50%) females. The population of subjects in pre- primary school was 4 (1.6%), that for primary school was 119 (46.1%) and that in secondary school was 135 (52.3%).

Table1: Frequency distribution of socio-demographic variables in the study populace

Age Range (Years)	Gender		
	Male (%)	Female (%)	Total (%)
5 – 7	10(3.9%)	12(4.7%)	22(8.5%)
8 – 10	22(8.5%)	25(9.7%)	47(18.2%)
11 - 13	50(19.4%)	52(20.1%)	102(39.5%)
14 ≤ 16	47(18.2%)	40(15.5%)	87(33.7%)
Total	**129**		**258**

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In **table2,** the distributions of Squint for male children in the study population was shown. Amongst the total sample of 258 participants screened, 13 cases of squint were identified. Of this number, 5 cases were boys. Thus the prevalence of squint is 5% of the study sample. The prevalence of squint for boys is 5 (1.9%). Esotropia was the most common type of deviation among the boys and it accounted for 4 (1.6%) of the cases with Exotropia having just 1(0.4%). The 8 – 10yrs age group accounted for 1(0.4%) case of esotropia and the only case of exotropia 1(0.4%) among the boys. The 11 – 13yrs age group recorded the highest number of squint amongst the boys 2(0.8%) in the study sample. The 5 -7years age group had least number of squint cases 1 (0.4%).

Table2: Age distribution of male children with Squint in the study populace.

Age Range (Years)	Normal Binocular Vision (Males)	Types of Squint		
		Esotropia	Exotropia	Total Squint (%)
5 - 7	10	1	-	1 (0.4%)
8 – 10	22	1	1	2 (0.8%)
11 – 13	50	2	-	2 (0.8%)
14 ≤ 16	47	-	-	-
Total	**129**	**4**	**1**	**5 (2.0%)**

Table 3 shows age distribution of female children with Squint in the study sample. The of prevalence of squint for girls was 8 (3%) out of the total 13(5%) cases in the study sample. Esotropia was also the most common among them with 5 (1.9%) and exotropia 3 (1.2%). Esotropia, in this study, was seen to be the most prevalent type of Squint seen in 9 (3.5%) while Exotropia was seen in 4 (1.6%). The 11- 13 ages group presented with most of the squint cases of 6 (2.3%) out of the 13 (5%) total squint prevalence reported in the study. It is also worthy to note that the 14 -16 ages group recorded no squint.

Table 3: Age distribution of female children with Squint in the study sample.

Age Range (Years)	Normal Binocular Vision (Females) (%)	Types of Squint		
		Esotropia	Exotropia	Total Squint
5 - 7	12	-	-	-
8 – 10	25	1	1	2 (0.8%)
11 – 13	52	4	2	6 (2.3%)
14 - ≤ 16	40	-	-	-
TOTAL	**129**	**5**	**3**	**8 (3.1%)**

In **Figure 1**, it was observed that refractive error was the major condition implicated for the cause of squint 6 (2.33%) out of the 13 total Squint cases reported. Refractive error cases were 4 (1.6%) girls and 2 (0.8%) boys. Positive family history accounted for 1(0.39%) of the cases, amblyopia, cataract and congenital factors accounted for 2 (0.78%) of the cases respectively**.** The 2 cases reported with congenital factors were interestingly all girls.

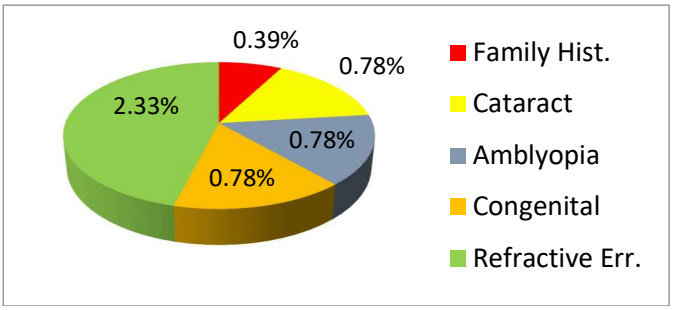

Figure 1: Distribution of the cause(s) of Squint

Table 4: Prevalence of Squint in the study population.

Age(Years)	Squint Cases	Normal	Total
5 – 7	1	21	22
8 – 10	4	43	47
11 – 13	8	94	102
14 ≤ 16	-	87	87
Total	**13**	**245**	**258**

1. **HO:** There is no significant relationship between the prevalence of squint and age in the study population.
2. **HA:** There is a significant relationship between the prevalence of squint and age in the study population.

Chi Square (x^2) cal = 494.3 > (x^2) crit = 3.84, which is statistically significant.

Thus the null hypothesis which stated that there is no significant relationship between the prevalence of Squint and age was rejected. That is, there is a significant relationship between the prevalence of Squint and age in the study population.

Table 5: Gender and Squint distribution in the study population.

Gender	Squints cases	Normal	Total
Male	5	124	129
Female	8	121	129
Total	13	245	258

1. **HO:** There is no significant difference in gender distribution of squint in the study population.
2. **HA:** There is a significant difference in gender distribution of squint in the study population.

   X^2 α = 0.05(5%)

   Chi Square (x^2) cal = 129.0

Thus the null hypothesis of no significant difference was rejected. That is, there is a significant difference in gender distribution of Squint in the study population.

Table 6: Gender and Squint dominance in the study population.

Gender	Squints			Total
	Esotropia	Exotropia	Normal	
Male	4	1	124	129
Female	5	3	121	129
Total	9	4	245	258

1) **HO:** There is no significant gender difference in squint dominance in the study population.
2) **HA:** There is a significant gender difference in squint dominance in the study population.

   X^2 α = 0.05(5%)

   Chi Square (x^2) cal = 19.59

Thus the null hypothesis of no significant gender difference was rejected. That is, there was a significant gender difference in squint dominance in the study population. This is because there were 8 (3%) number of squint cases for females, among these reported cases, 5(2%) presented with Esotropia while 3(1.2%) with Exotropia. Males recorded 5 (1.9%) cases with 4(1.6%) Esotropia and 1(0.4%) Exotropia. This makes Esotropia the most dorminant form of squint; and most common with the female gender.

DISCUSSION

Subjects from the last two age ranges (11–13 years and 14 ≤ 16 years) recorded the highest participation in the study, totaling 189 (73.3%). This could be attributed to the fact that children in this age group tend to experience more visual complaints due to increased visual demands in school and are less dependent on their parents or guardians to take them to the clinic, as was observed during the study.

The squint prevalence of 5% in this study is comparable to that reported in other Nigerian and international studies, which found prevalence rates ranging from 4.3% (Bodunde*et al.,* 2016) to 4.4% in Southern Ethiopia, 3.1% in the United States, and 3.98% in Ireland (Durnian*et al.,* 2011; Dean, 2019). However, higher rates have been reported in certain regions. Akpe*et al.* (2014) found a prevalence of 53.6% in Benin City, Nigeria, while Azam *et al.,* (2019) reported 40% in Pakistan, Noche *et al.* (2011) found 10% in Cameroon, and Nwachukwu *et al.* (2019) reported 6.6% in southeastern Nigeria. Conversely, lower prevalence rates have been observed elsewhere; Taha and Ibrahim (2015) reported a prevalence of 1.8% among six-year-olds in the Sydney Myopia Study, while in Nigeria, the rate varied regionally—0.4% in the South, 2% in the North, and 0.06% in the East (Bodunde*et al.,* 2016).

All reported squint cases in this study were lateral deviations, with esotropia being the most common

form (3.5%) compared with exotropia (1.6%). Among the 13 cases of squint identified, 9 (3.5%) were esotropia and 4 (1.6%) were exotropia. Esotropia was more common among females (1.9%) than males (1.6%). Taha and Ibrahim (2015) similarly found esotropia to be more prevalent (2.2%) than exotropia (0.4%). However, other studies reported a predominance of exotropia. For instance, in Cameroon, exotropia accounted for 75% of cases (Noche *et al.,* 2011), while in Iran, exotropia accounted for 1.30% compared with esotropia at 0.59%. The variation in esotropia and exotropia prevalence across different regions may be linked to environmental and racial factors. Sihota *et al.,* (2011) suggested that the duration and intensity of sunlight, as well as genetic predispositions, may play a role, proposing that higher light intensity could increase exotropia frequency. However, the higher prevalence of esotropia in this study, despite high sunlight intensity in our region, contradicts that hypothesis.

Refractive error was the major condition implicated in the etiology of squint in this study, accounting for 6 (2.33%) out of the 13 total cases, with 4 (1.6%) among girls and 2 (0.8%) among boys. Positive family history accounted for 1 (0.39%) of cases, while amblyopia, cataract, and congenital factors each accounted for 2 (0.78%). The two congenital cases occurred in females. Akpe*et al.,* (2014) similarly reported refractive error as the main cause of squint in school children in Benin City. Poor parental awareness and low health-seeking behavior regarding children's vision problems are contributing factors in many African settings (Pathai*et al.,* 2010). Parents often fear spectacle use, leading to delayed diagnosis and treatment. Low socioeconomic status and limited access to eye care services further exacerbate late detection (Muma *et al.,* 2017). Additionally, parents and teachers often fail to recognize early signs of visual disorders, which may allow minor refractive deviations to progress to manifest strabismus. This pattern aligns with Pathai*et al.,* (2010), who emphasized that uncorrected refractive error is strongly associated with the development of strabismus. Lack of parental awareness about the consequences of untreated squint remains a key barrier to early intervention (Azam *et al.,* 2019).

Positive family history was another contributing factor. In this study, 0.39% of cases had familial association, consistent with Noche *et al.,* (2011), who found that 37.5% of cases and 3.1% of controls had a positive family history, with hereditary cases being 20 times more likely to develop strabismus. Poor record-keeping and limited access to perinatal data made it difficult to assess birth weight and prematurity as risk factors in this study. However, congenital cases (2, or 0.78%) were recorded, aligning with literature suggesting that low birth weight and prematurity are important contributors to congenital strabismus (Mwanza, 2012).

The Chi-square analysis revealed a statistically significant relationship between age and squint prevalence ($\chi^2 = 494.3$, $p < .05$). This finding agrees with earlier reports that strabismus prevalence in children varies with age and ethnicity, ranging from 0.8% in Singapore to 5.65% in China (Xu, 2012). In the MEPEDS and Baltimore Pediatric Eye Disease Studies, astigmatism ≥2.5 D was associated with a sixfold increased risk of exotropia in children aged 6 to 72 months (Cotter *et al.,* 2011). Similarly, *Zhu et al.* (2015) reported that refractive error is significantly associated with concomitant esotropia and exotropia in children aged 3 to 6 years. These results are consistent with the present findings, though the highest prevalence occurred among older children (11–13 years) in this study, possibly reflecting increased awareness and reporting in that age group.

Chi-square analysis of gender and squint distribution also showed a significant gender bias, with female preponderance ($\chi^2 = 129.0$, $p < .05$). This is consistent with Awoyesuku*et al.* (2016), who found that 68.9% of strabismus cases occurred in females compared with 31.1% in males. However, Abah *et al.* (2011) observed a male predominance (59.4%) in congenital cataract–related strabismus cases, while Polling et al. (2012) found no significant gender difference. Interestingly, Polling et al. also reported that males tend to present later to clinics than females, which could explain the female dominance in this study.

Chi-square analysis of gender and squint dominance also revealed a statistically significant skew toward females ($\chi^2 = 19.59$, $p < .05$). Esotropia, the dominant form of squint in this population, was more common among females (1.9%) than males (1.6%). These findings align with Taha and Ibrahim (2015), who also found esotropia to be more common than exotropia, with a prevalence of 2.2% and 0.4%, respectively.

CONCLUSION

The prevalence of squint for children aged between 5 – 15years in this study was 5%.The prevalence of squint was higher in the female population (3% out of the total of 5%) that was recorded in the study. Similarly, the population of Esotropia (3.5%) was the most dominant form of squint as against Exotropia (1.6%) in the study population.

It was observed that age has influence on the time of onset of squint. Subjects from the age ranges (11-13yrs) recorded the highest participation of 189 (73.3%). This also represented the highest number of squint 8(3%) in the study population.

The relationship between the prevalence of squint and age in the study population was statistically significant at confidence interval x^2 $\alpha = 0.05(5\%)$; Chi Square (x^2) cal = 494.3 > (x^2) critical = 3.84. Thus the null hypothesis of no significant association between the occurrence of squint and age was rejected.

RECOMMENDATIONS

i. Teachers and other non-ophthalmic personnel should be taught and encouraged to report squint and visual anomalies in children for prompt intervention.

ii. Government and Non-Governmental Organizations (NGOs) should consider a school based annual checkup for all children to enable the early detection of uncorrected refractive errors, squint as well as other conditions that can cause squint.

iii. School authorities should adopt eye examination as entry level as well as yearly vision screening for their students and pupils to detect the presence of refractive errors, squint as well as other conditions that can cause squint.

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