Refractive Error among Strabismic Children in Ilorin, Nigeria

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SUMMARY

Objectives: This study was conducted to determine the pattern of refractive errors among a group of strabismic children.

Methods: A cross sectional survey was carried out among primary school children in Ilorin South Local Government area of Kwara State, Nigeria to isolate those with manifest strabismus. These children with manifest strabismus then underwent a full ocular examination followed by an objective refraction using a Topcon 8000^{R} autorefractometer without cycloplegia and then a subjective refraction.

Results: Of the 7288 children screened, there were 32 cases of strabismus (22 esotropia and 10 exotropia) consisting of 19 males and 13 females (M: F = 1.5:1). Hypermetropia was the commonest refractive error among the children (50%) followed by astigmatism (30%) and myopia (20%). There was more astigmatism among esotropic children (66.7%) compared to exotropic children (33.3%). Majority of the hypermetropia (85%) was associated with esotropia while most of the myopia (62.5%) was associated with exotropia. The prevalence of significant refractive error was found to be 34.4% (95% CI, 34.2 – 34.6). A great proportion of the refractive errors are in the mild and moderate category. It was only among hypermetropic children that refractive errors greater than ±5.0DS/Cyl in any meridian was found.

Conclusion: There is a high prevalence of significant refractive error in the study population. Hypermetropia is the dominant refractive error seen in this study and most of it is found among the esotropic children. There was more myopia among exotropic children compared to esotropic ones but the difference is not statistically significant.

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INTRODUCTION

The pattern of refractive error in children is variable as they progress through the growing years of life[1]. In the early years of life the vast majority of children are hypermetropic while a few are myopic with others being astigmatic or emmetropic[2]. However, there is a trend towards emmetropia if the refraction is either mildly myopic or less than +2.50D hypermetropic. Above this level the refraction is more or less hypermetropic[3].

In various regions of the world, there is a high variability in the distribution of the various forms of refractive error in children. Among Ugandan children, astigmatism is the commonest error of refraction followed by hypermetropia and myopia in that order[4]. In India hypermetropia is the commonest error of refraction followed by astigmatism and myopia[5]. In the kazuhiro study among Japanese Children[6] myopia was found to be the commonest error of refraction followed by astigmatism and hypermetropia.

In most of these studies there was no attempt to separate the strabismic and the non-strabismic children in the analyses. In the literature few publications were devoted to the pattern of errors of refraction among strabismic children. Among the West Indian children, hypermetropia was the commonest errors of refraction followed by myopia and astigmatism in that order[7] while in Ibadan, Nigeria[8], hypermetropia was also the commonest but followed by myopia.

In order to better understand the aetiology of strabismus especially as it relates to refractive errors, it is important to know the pattern refractive errors among strabismic children because early correction is necessary to prevent the complication of strabismic amblyopia. This study was therefore undertaken to determine the pattern of refractive error in a group of strabismic children in Ilorin, Nigeria.

MATERIALS AND METHODS

This study was done among primary school children in Ilorin South Local Government Area of Kwara State between October 2005 and September 2006.

Sample Size Determination: The desired sample size was calculated to be 21, using the formula $n=Z^2pq/d^2$ (where z = standard Normal Deviate, P = Proportion of target estimated to have strabismus obtained from a similar study in Western Nigeria, q = 1.0 – p, d = probability of error at the 95% confidence limit). Allowing for a 20% non-response the final sample size came to 26.

Sampling Design: A cluster random sampling design was used to select the subjects for this study. First, each of the 33 public primary schools in Ilorin south Local Government Area, representing a cluster, was allocated a number from 01 to 33. From a sample frame of these 33 schools, 21 were randomly selected. Every eligible member of the selected cluster was screened for ocular misalignment and every subject who had strabismus and satisfied the inclusion criteria was selected for the study.

Consent was obtained from the Education Authority of Ilorin South Local Government, the parents of the children and the head teacher of each participating school before the commencement of the study. Ethical clearance was obtained from the University of Ilorin Teaching Hospital Ethical Committee and all the guidelines for research involving human subjects were strictly adhered to.

Inclusion/Exclusion Criteria: All primary school children found to have

strabismus were included in the study. The subjects were limited to only children with strabismus from the selected schools. Children who had squint associated with other ocular pathologies such as cornea scar, cataract, macular scar, optic atrophy, etc or central nervous system disorders such as cranial nerve palsies were excluded.

Procedure: Children in the selected schools were screened for ocular misalignment at distance and near using the Hirschberg's method and cover and uncover tests. Every child in each selected school was screened by an ophthalmologist (I.R) with the assistance of the class teacher in every visited classroom who helped to co-ordinate the children. Those found to have ocular misalignment were transported to the Ayo Bello Memorial Centre along with their class teacher for full ocular examination.

Their visual acuity was tested using the Snellen's letter and illiterate E-charts. The E-chart was used for children who could not comprehend the Snellen's letter optotypes irrespective of age. Extraocular motility assessment was carried out followed by anterior segment examination using a bright pen torch. A non-cycloplegic objective (using a Topcon 8000^R autorefractometer) and a subjective refraction was carried out on each child and the result documented in a proforma designed for the study. Detailed funduscopy was carried out using direct and indirect ophthalmoscopes after dilatation of the pupils with 1% tropicamide eye drop. All children with manifest strabismus including those with refractive errors were referred to the University of Ilorin Teaching Hospital, Ilorin at the end of the examination.

Hypermetropia was defined as refractive error equal to or greater than +0.50Ds while myopia was defined as an error of refraction equal to or greater than -0.50Ds. Astigmatism was defined as an error of refraction equal to or greater than plus or minus 0.50D cyl in any meridian. Significant hypermetropia is hypermetropia equal to or greater than +3.5Ds while significant myopia is myopia equal to or greater than minus 3.0Ds. Significant astigmatism is astigmatism equal to or greater than plus or minus 2.0Dcyl in any meridian.

Statistical analyses: All data were cross checked, entered and analysed using Epi-info 6.04, Statistical Package for Social Sciences (SPSS) 12.02 and a pocket size scientific calculator. Distribution was described as mean and standard deviation and x^2 was used to determine the statistical significance of the difference between proportions. The level of significance was taken to be $p<0.05$.

RESULTS

Over the one year period of the study, 7288 elementary school children (3766 boys, 3522 girls) were screened in 21 public primary schools and this yielded 32 cases of strabismus (22 cases of esotropia and 10 cases of exotropia). Table 1 gives the age/sex distribution of the strabismic children.

Table 1
Age and sex Distribution of School Children with Strabismus

Age (yrs)	Sex		Total n (%)
	Male n (%)	Female n (%)	
2 – 5	2 (6.3)	2 (6.3)	4 (12.5)
6 – 9	8 (25.0)	4 (12.5)	12 (37.5)
10 – 13	8 (25.0)	6 (18.8)	14 (43.9)
14 – 16	1 (3.1)	1 (3.1)	2 (6.3)
Total	19(59.4)	13 (40.6)	32 (100.0)

The age of the strabismic children ranged from 4 -16 years (mean 9.5±5.992 years). Majority of the children were in the 6 – 13 year age groups. There were 19 males and 13 females giving a male: female ratio of 1.5:1.

Table 2 gives the distribution of errors of refraction among the strabismic children. Hypermetropia is the commonest error of refraction among these children (50%) followed by astigmatism (12%). Up to 11 (34.4%) of the children had significant error of refraction.

Table 2
Distribution of Errors of Refraction among the Strabismic Children

Error of Refraction	Number		Total (%)
	Significant	Non-Significant	
Hypermetropia	6	14	20 (50)
Astigmatism	2	10	12 (30)
Myopia	3	5	8 (20)
Total	11	29	40 (100)

Majority of the hypermetropia (85%) was associated with esotropia while most of the myopia was associated with exotropia, table 3.

Table 3
Association of Error of Refraction with Type of Strabismus

Strabismus	Error of Refraction		
	Hypermetropia	Myopia	Astigmatism
Esotropia	17 (85)	3 (37.5)	8 (66.7)
Exotropia	3 (15)	5 (62.5)	4 (33.3)
Total	20 (100)	8 (100)	12 (100)
p-value	<0.05	>0.05	>0.05

The trend is that hypermetropia is strongly associated with esotropia but not as much with exotropia ($p<0.05$). No such strong association was found between any of the other errors of refraction with either esotropia or exotropia.

Table 4 gives the severity of errors of refraction among this group of strabismic children.
Table 4
Degree of Error of Refraction among Strabismic Children

Degree of Error	Type of error of Refraction		
	Hypermetropia	Myopia	Astigmatim
Mild	13 (65)	7 (87.5)	10 (83.3)
Moderate	5 (25)	1 (12.5)	2 (16.7)
Severe	2 (10)	-	-
Total	20 (100)	8 (100)	12 (100)

Most of these children have mild errors with errors greater than +5.0D found only among the hypermetropic children.

DISCUSSION

A large proportion (87.5%) of the children seen in this study had error of refraction. This is slightly lower than the 90.3% obtained among strabismic children seen by Vladucin[9] in Romania, probably because this study involved younger children. In our study 50% of the error of refraction was due to hypermetropia while 30% and 20% respectively were due to astigmatism and myopia. Baiyeroju and Owoeye[8] at Ibadan and Eustace[7] in Birmingham made similar observations. In Ibadan, hypermetropia and myopia constituted 45% and 20% of errors of refraction respectively while in Birmingham among West Indian children hypermetropia, myopia and astigmatism respectively constituted 67.7%, 27.7% and 4.6% of errors of refraction.

The prevalence of significant error of refraction in this study was found to be 34.4%. In several other studies[4, 6, 10, 11] from various parts of the world the prevalence of error of refraction is between 8.2% and

18.5%. The high prevalence of significant error of refraction among strabismic children compared to children with normal ocular alignment and the overall high prevalence of error of refraction among them may suggest slow or defective emmetropization in these children. This is collaborated by the findings of Lefferstra[12] in Germany and those of Ingram et al[13] in the Netherlands. Lefferstra found that in unilateral strabismus emmetropization lagged behind in the non-fixating eye while in alternating strabismus emmetropization is similar in both eyes. Ingram et al found that emmetropization is deficient in at least 80% of the eyes of strabismic children irrespective of their refraction in infancy and that this deficiency is more in the non-fixating eye in bilateral strabismus.

In our study, majority of the hypermetropia (85%) was associated with esotropia while majority of myopia (62.5) was associated with exotropia. This is similar to the findings of Baiyeroju and Owoeye[8] in Ibadan and those of Abrahamsson et al[14] in Sweden. In Ibadan 89% of the hypermetropia was associated with esotropia while 75% of the myopia was found among patients with exotropia. In Sweden more than 60% of the esotropic patients had hypermetropia while none exhibited a myopic refraction. While it seemed certain that some relationship exists between esotropia and hypermetropia, same cannot be said of exotropia and myopia with any degree of certainty. Larger studies are required to explore this.

Most of the error of refraction found in this study was mild in degree. Only 10% of the children had severe hypermetropia, a finding that does not differ from the situation in non-strabismic children[2]. Not all children with sever errors of refraction develop strabismus[15]. This suggests that in addition to error of refraction other factors also interplay in a complex way to determine which child would develop strabismus and which one would not.

Conclusion: The prevalence of error of refraction including significant error of refraction is high in our study population of strabismic children. Majority of the error of refraction is hypermetropia and this is often associated with esotropia. The relationship between myopia and exotropia is not clear and require larger studies to elucidate. As screening for error of refraction among primary school children and its subsequent correction may help reduce the occurrence of strabismus and therefore limit its social consequences, a national policy on pre-school and periodic school eye screening exercise as the practice in developed countries is recommended.

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