Original Article

Prevalence of Amblyopia among Secondary School Students in Calabar, South-South Nigeria

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ABSTRACT
PURPOSE: To determine the prevalence of amblyopia among secondary school students in Calabar metropolis
METHODS: It was a cross-sectional study with subjects recruited by multi-stage simple random technique. A total of 1,241 students were eligible of which 1,175 were available for vision screening with Snellen's chart. Students whose visual acuities (VA) were <6/9 in at least one eye met the inclusion criterion for refraction. While those with visual acuities >6/9 in either eye were considered emmetropic. History, ocular alignments, anterior and posterior segment examinations were carried out. Students with best-corrected VA<6/9 in either of the eyes with no identifiable pathology were considered amblyopic. Data analysis was by SPSS 15.0 (2008)
RESULTS: Of the screened students, there were 535 males and 640 females (X^2 = 16.439, P=0.088). The age range was 9-21 years. One thousand nine hundred and four (93.1%) had VA6/9 in both eyes (i.e. 6/9 in each eye tested separately). Of the 81(6.9%) with VA 6/9 who meant the criterion for refraction, 61 (5.2%) were refracted to at least 6/9 in both eyes. The amblyopia prevalence was 0.3% (95% confidence interval [CI], 0.27 - 0.35) with no sex (*P-value* = 0.088) effects but showed statistical significance with age (chi-square, X^2 = 140.954, P-value = 0.000)
CONCLUSION: The prevalence of amblyopia in this study is relatively low compared to other African and non-African studies.
KEY WORDS: Amblyopia, Calabar, prevalence figures, visual acuity.

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INTRODUCTION

Derived from the Greek word amblyos (meaning dull) and opia (meaning vision), amblyopia refers to decreased best-corrected visual acuity (BCVA) in the absence of visible organic abnormalities.[1-3] It is primarily a cortical phenomenon caused by unequal competitive inputs from the two eyes. This arises from misdirected, blurred or absent retinal images into primary visual cortex, area 17 during development of the visual system. Also, structural and functional abnormalities have been established in the lateral geniculate nucleus of amblyogenic animals and humans.[2,4,5]

The incidence of amblyopia in the preschool years is approximately 0.4 percent per year.[6] With the prevalence after this period of approximately 2 percent, the annual incidence in the general population can be broadly estimated by assuming that 2-3 percent of healthy infants born each year will suffer visual loss from amblyopia.[6,7]

The prognosis for success is generally good, especially if amblyopia is diagnosed and treated early. Optical correction, occlusion, and vision therapy are the major treatment options.[5] The presence of amblyopia or its risk factors, mainly strabismus or refractive error, have been primary conditions targeted in childhood vision screenings. Continued support for such screenings requires evidence-based understanding of the prevalence and natural history of amblyopia and its predisposing conditions as currently emphasized in this study. The findings from this study will form basis for appropriate recommendations.

MATERIALS AND METHODS
Background- This study was carried out among 51 secondary schools in the two Local Government Areas of Calabar, the metropolitan state capital of Cross River State.

Study design
It was a cross-sectional study conducted over a three month period (23rd November, 2009 to 26th March, 2010). The study was temporarily put on hold because of a holiday between 15th December, 2009 and 17th January, 2010 in all secondary schools in Calabar metropolis.

Inclusion criteria
Must be a bonafide student of the participating schools and must grant informed consent

Exclusion criteria
Students not selected through the sampling processes or refusal of participation.

Sample technique
Using reported prevalence figure of 3.3%[8], the calculated sample size was 1,241. A multistage system of sampling was used.

Stage 1: Four secondary schools were randomly selected by balloting process, 2 from each of the Local Government Areas that make up Calabar metropolis. Four schools have been estimated to provide the calculated sample size based on students' population in each school obtained from Ministry of Education. The 4 participating schools were selected by simple random

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sampling using numbered list of names of schools obtained from the state Ministry of Education. Based on the respective Local Government Area, each school was written on sheets of papers and then wrapped, separating private from public schools. A neutral person then assisted in picking a wrapped paper on which the name of a school has been written. By this technique, 4 schools were chosen in 2 categories in each of the Local Government Areas.

Stage 2: Classes were chosen across JSS 1 through SS3 (junior to senior classes) by second stage simple random sampling from each of the 4 selected schools. The technique for selecting a class from other arms of that class was similar to that in first stage simple random sampling. Based on the numbers of arms of a class, a neutral person also assisted in picking a paper from each class until 6 arms were randomly selected, from JSS1 to SSS3 in each of the 4 participating schools making a total of 24 arms of classes.

Stage 3: By proportional allocation, respondents were recruited based on the numbers of students in each register of the 24 classes. Proportional allocation was also used to recruit respondents based on sex as each register has female students separated from male students. Some classes had relatively few students and all the students were recruited while other classes were large such that random numbers generated were used to exclude some students until the sample size was reached.

MATERIALS
Snellen 'E' chart, Pen-torch with dry-cell batteries, Pin-hole, Near reading test type (Rayners), Refraction, Occluder, Trial frame, Trial box, Trial lenses, Jackson cross cylinder, Black window blinds, Cyclopentolate eye drops 1% (Alcon), tropicamide l% (manufactured by ECWA Central Pharmacy Ltd, Jos), Streak retinoscope (Welch Allyn), Ophthalmoscope (Welch Allyn) and batteries (3 volts, medium-sized Dura-cell).

METHODS
VA (unaided, with pin-hole, with glasses if available and near chart) was done with standard Snellen's 'E' chart (used to discourage memorization) from a distance of 6 meters. To ensure quality assurance, a minimum performance level of the field assistants acceptable was a VA consistent to the author's value in 4 of 5 randomly selected screened students. Students who had unaided VA 6/9 in at least one eye were confirmed by the author and were subsequently refracted (with or without cycloplegia). Cycloplegic refractions were carried out at close of school on Fridays to limit effects on academic activities. Post-cycloplegic refractions were carried out the following Mondays during break hours or at close of school. Following refraction, students who could not be improved to 6/9 in either eye in the absence of ocular pathology were considered to have amblyopia as the

cause of reduced vision. All the students suspected to have amblyopia had corneal reflex test (Hirschberg) and cover-uncover test to rule out ocular misalignment.

Data collection Team
The research team and their roles are stated below:

Author
carried out anterior and posterior segment examinations and refraction. Author also took history which included previous surgery, spectacle use and previous examination by eye care personnel.

Ophthalmic nurse and ophthalmic assistant
carried out VA screening. Both the ophthalmic nurse and the ophthalmic assistant were recruited from the eye clinic of the University of Calabar Teaching Hospital.

Study definition
Amblyopia was defined as subjective refraction with VA<6/9 in the absence of identifiable ocular pathology in either eye. Nkanga et al[9] reported that using VA<6/9 in the better eye as the basis of screening in refractive error studies show high specificity (95.2%) and high predictive value (67.6%). Several population-based studies[8, 10-12] on refractive errors have used VA<6/9 in either eye as the basis for refraction. This informed the choice of 6/9 as cut-off for emmetropia in this study to allow comparison of results.

DATA ANALYSIS
Data was analyzed with SPSS 15.0 (Statistical Package for Social Sciences, version 2008). Prevalence was calculated as the ratio of the number of individuals with amblyopia to the total number of screened students. Descriptive statistics included frequencies, mean and standard deviations. Exact binomial 95% confidence interval (CI) was calculated for the prevalence estimate with Poisson distribution. Categorical variables were compared by chi-square test. P-value < 0.05 was considered statistically significant.

Ethical considerations - Ethical clearance was obtained from the Ethical Review Committee of the University of Calabar Teaching Hospital. Written informed consents were obtained from participating students and same form taken to their parents for accent. Permission was also sought from Cross River State Ministry of education through the Commissioner of education. Study protocol was in keeping with the tenets of Helsinki declaration.

RESULTS
A total of 1,241 secondary school students were eligible in the four secondary schools. 1,175 students (94.7%) were actually screened for refractive errors. The 66 (5.3%) excluded from screening were absent for various reasons including withdrawal from the schools(7), transfers to other schools(28), inability to pay school

fees(13), protracted illness(1) and relocation of parents(17).The age range was 9 to 21 years, with a mean age of 13.81.5. There were 535 males and 640 females with a male to female ratio of 1:1.2. Cross-tabulation of sex and all diagnoses showed X^2 = 16.439, P=0.088, which was not statistically significant. The age and sex distribution of the study population is as shown in table 1.

Table I: **Age and sex distribution of 1175 screened secondary school students**

Age (Yrs)	Male	%	Female	%	Total	%
<10	13	1.1	19	1.6	32	2.7
10<13	255	21.7	237	20.2	492	41.9
13<16	240	20.4	369	31.4	609	51.8
16<19	18	1.5	9	0.8	27	2.3
19	9	0.8	6	0.5	15	1.3
	535	45.5	640	54.6	1175	100

The largest 369 (31.4%) number of female patients were between 14 and 16 years. However, more males 255 (21.7%) were between 11 and 13 years. Majority of students screened 1101 (93.7%) were between the age bracket of 11 to 16 years. Cross-tabulation of age and diagnoses showed X^2 = 140.954, P= 0.000, which was statistically significant.

Table II: **Age distribution of VA in the better and worse eyes of 1175 secondary school students**

Better Acuity	Age (years)					Total
	<10 n(%)	10<13 n(%)	13<16 n(%)	16<19 n(%)	19 n(%)	n
6/5-6/6	13(2.6)	230(45.3)	251(49.4)	6(1.2)	8(1.6)	508
<6/6-6/9	19(3.2)	235(39.4)	314(52.7)	21(3.5)	7(1.2)	596
<6/9-6/12	0	3(33.3)	6(66.7)	0	0	9
<6/12-6/18	0	7(43.8)	9(56.3)	0	0	16
<6/18-6/24	0	4(21.1)	15(78.9)	0	0	19
<6/24-6/36	0	9(47.4)	10(52.6)	0	0	19
<6/36-6/60	0	4(50)	4(50)	0	0	8
Total	**32(2.7)**	**492(41.9)**	**609(51.8)**	**27(2.3)**	**15(1.3)**	**1175**
Worse Acuity						
6/5-6/6	9(2.0)	198(44.5)	231(51.9)	3(0.7)	4(0.9)	445
<6/6-6/9	23(3.5)	265(40.8)	326(50.2)	24(3.7)	11(1.7)	649
<6/9-6/12	0	3(27.3)	8(72.7)	0	0	11
<6/12-6/18	0	4(22.2)	14(77.8)	0	0	18
<6/18-6/24	0	11(52.4)	10(47.6)	0	0	21
<6/24-6/36	0	6(28.6)	15(71.4)	0	0	21
<6/36-6/60	0	3(37.5)	5(62.5)	0	0	8
<6/60	0	2(100)	0	0	0	2
Total	**32(2.7)**	**492(41.9)**	**609(51.8)**	**27(2.3)**	**15(1.3)**	**1175(100)**

In table 2 is shown the age distribution of VA in all screened students. 1104(94%) students had VA6/9 in the better eye. One thousand nine hundred and four (93.1%) students with uncorrected VA6/9 in either eye (i.e. 6/9 in each eye when tested separately) were considered emmetropic. The remaining 81(6.9%) students had VA<6/9 in at least one eye. The causes of reduced vision in these 81 students are shown in the figure below. Refractive errors were responsible for 61(5.2%), ocular pathology 20(1.4%) and amblyopia 4(0.3%), (95%

confidence interval [CI], 0.27 - 0.35). Of those with amblyopia, all of whom were males, 2 each were compound and mixed myopic astigmats.

Figure: Causes of impaired vision in the worse eyes of 81 secondary school students in Calabar
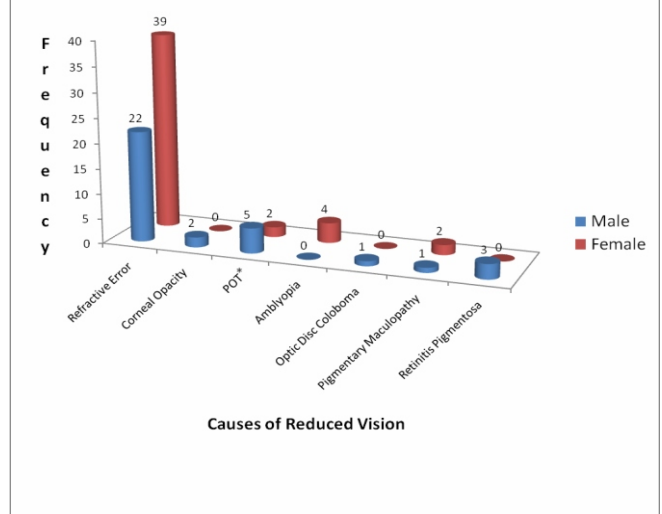
DISCUSSION

The prevalence of amblyopia in this study was 0.3 per cent. All the patients found amblyopic were males. However, no statistical significance was noticed when sex was cross-tabulated with all diagnoses made in the study. In a cross-sectional study of 3009 Singaporean children, Audrey et al[13] found neither age nor sex association with amblyopia. However, age was found to be statistically significant with amblyopia in the current study (P= 0.000).

Controversy over which VA criteria should be adopted for the clinical definition of amblyopia has caused differences in the prevalence of amblyopia.[14-17] Estimates of the prevalence can vary substantially depending on which criteria and population are selected.[13-20] This survey was carried out among fully cooperative school children of 9 to 21 years of age, and a VA of <6/9 after subjective refraction used as criterion, so that the maximum amblyopia prevalence rate of 0.3 per cent (95% CI, 0.27-0.35) was probably detected.

Reports[11, 21-26] from African and non-African countries show prevalence figures of amblyopia ranging from 0.4 to 7.3 per cent. In South Africa, Naidoo et al[21] reported 7.3%, Nigeria, Adegbehingbe et al[22] reported 3.3% and Tanzania, Wedner et al[11] reported 0.4%. Reports from Non-African countries also show varied prevalence figures in the order of 0.7%[23], 1.7%[24], 1.9%[25] and 3.9%[29]. The study settings and definitions, the sampled population and location could account for the differences in these studies.

This study carried out among predominantly Nigerian student population recorded a much lower figure than a

similar study[22] in Nigeria. Both studies though used the same VA criterion and relatively similar student population, the settings of the two studies were remarkably different. This study was conducted in a cosmopolitan state capital in South-south Nigeria, while the other study was conducted in a semi-urban town of predominantly Yorubas in South-western Nigeria. Perhaps, students in the state capital are more likely to have access and wherewithal for corrective vision services, especially in early childhood. Ethnic differences could also account for the disparity in these Nigerian studies. The influence of race and tribe on refractive errors has been established in several studies.[27-30] But there is paucity of reports of similar effects on the prevalence of amblyopia. However, refractive amblyopia being the major burden of amblyopia, one could expect increased amblyopia prevalence figures were you have significant untreated refractive errors in childhood.

The cause of amblyopia in this study was refractive. All the four students had unilateral meridional amblyopia. There were no cases of ocular misalignments or history suggestive of sensory deprivation during childhood. This is similar to several studies[13, 18-20] that refractive errors are the commonest causes of amblyopia.

LIMITATIONS OF THE STUDY
Not all students identified and enrolled for refraction presented. This could cause a bias of either a higher or lower prevalence figures. But the high participation rate and the meticulous screening protocol allowed for achievement of study's objective. Focused group discussion involving the parents could have enhanced the reliability of history obtained from the subjects regarding childhood visual status.

CONCLUSION
The prevalence of amblyopia among secondary school students in Calabar metropolis was lower than those reported in African and non-African studies.

RECOMMENDATION
To identify children at risk of developing amblyopia, pre-school vision screening is recommended. The aim is to detect and treat amblyogenic factors early enough before amblyopia develops.

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