The Internet Journal of Ophthalmology and Visual Science
Volume 10 Number 1

Visual Impairment Among School Children - Calabar Vision Screening Survey In Secondary Schools (CVS4 Study)

O E MEGBELAYIN, E U ASANA

Citation

O E MEGBELAYIN, E U ASANA. *Visual Impairment Among School Children - Calabar Vision Screening Survey In Secondary Schools (CVS4 Study)*. The Internet Journal of Ophthalmology and Visual Science. 2013 Volume 10 Number 1.

Abstract

Background: Inability to read materials on the blackboard can profoundly affect a child's participation and learning in the classroom. Therefore, early vision screening, and follow-up if necessary, would bring parents' attention to their child's visual status.
Aim: To determine the causes of visual impairment among secondary school students in Calabar metropolis.
Methods: It was an observational study conducted over three month. Four schools in Calabar metropolis were stratified and subjects recruited by multi-stage simple random technique. Subjects with visual acuity <6/9 in at least one eye were considered to have failed the vision screening test and were subsequently refracted. Data was analyzed using the Statistical Package for Social Sciences, version 15.0(2008).
Results: A total of 1,175 students participated in vision screening, males were 535 and females were 640 (M:F= 1:1.2) with a mean age of 13.86+1.5 (95% Confidence Interval, [CI] = 13.35-14.36). Of the 81(6.9%) students with VA 6/9 who meant the criterion for refraction, 61(5.2%) were refracted to at least 6/9 in both eyes while the remaining 20(1.7%) had pathology or amblyopia as the cause of reduced vision. The prevalences of causes of visual impairment were, in descending order, refractive errors 61(5.2%), presumed ocular toxoplasmosis 7(0.6%), amblyopia 4(0.34%), retinitis pigmentosa 3(0.3%), pigmentary maculopathy and degeneration 3(0.3%), corneal leucoma 2(0.2%), optic disc coloboma 1(0.08%).
Conclusion: uncorrected refractive error was the commonest cause of visual impairment among students in Calabar metropolis.

INTRODUCTION

Calabar is the metropolitan capital of Cross-River state in south-south Nigeria. Secondary school education in Calabar, like in other parts of Nigeria, is the next level of education after primary school. It is a compulsory phase in Nigerian educational system and preparatory to tertiary education. It is divided into two categories: junior and senior (JSS and SSS classes). Each category lasts for three years. The age range is about 10-18 years; although few students fall outside this age bracket. The population pyramid for third world countries is wide at the base, which means there are a large proportion of young people. School age children (6-15years) represent 20%-30% of the population of most third world countries.1 Nigeria by virtue of its population is estimated to bear nearly 25% of Africa's childhood blindness and visual impairment burden.1 Prevalence reports2, 3 of ocular morbidity across school children in Nigeria are often in excess of 10%.
Vision assessment in schools was initiated in 1908 to provide national data on the prevalence of disability and disease. It was only later, probably in the 1950s, that treatment was offered to children who were identified.4
Despite a lack of information about the costs and benefits of school vision screening and the frequency with which it should be carried out, it has been widely stated that it is important to screen children's vision regularly during the school years. For example, it has been recommended that children should be screened at school entry and at three yearly intervals thereafter, although no empirical evidence was offered to support this recommendation.5, 6
Pre-admission vision screenings are not yet routine in most public secondary schools in Nigeria. The implication of this is that students with poor vision, who could have been assisted if vision screening had identified them, perform poorly in their end of grade examinations (JSSCE and SSCE). Such poor performances may wrongly be attributed to mental retardation or 'unseriousness'.
The paucity of epidemiological studies which examined students' comprehensive ocular health status at the entry point of secondary school in Calabar creates a problem in that no baseline data is available in assessing and evaluating

students' overall visual status. In order to make a rational decision about the ocular status in secondary school students, it was decided to carry out school vision screening among these students in Calabar metropolis.

METHODOLOGY

Study design- It was an observational study.
Sample technique-
To qualify for selection, student must be a bonafide member of the participating schools and both students and at least a parent must grant informed consent. Ethical clearance was obtained from the Ethical Review Committee of the University of Calabar Teaching Hospital. Permission was also sought from Cross River State Ministry of education through the Commissioner of education. The success of our study hinged largely on advocacy visits paid to the principals of the selected schools and a copy of letter of permission from Education Ministry shown to them. This enabled us gain support and permission to carry out the study. Study protocol was in keeping with the tenets of Helsinki declaration.
The population of students in 51 registered secondary schools in Calabar metropolis was approximately 86,000 as at October 2009. Hence the formula used to calculate sample size was: N=Z2pq/d2. N is the minimum sample size required (when population >10,000), P is prevalence from previous study3 (Adegbehingbe 13.5% = 0.135), q is 1-p/100, d is degree of accuracy desired (0.02) and z is standard normal deviation of 1.96 (corresponds to the 95% confidence level {CI}). Thus the sample size calculated using the above formula was 1,128. To allow for attrition rate of at least 10%, the minimum sample size was then adjusted to 1,241. Stratified multi-stage simple random sampling was used to recruit students until the sample size was reached.
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 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.
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.
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.
Examination protocol:
A pilot study was carried in a secondary school that was not involved in the main study. This was to train team members and to standardize the study instruments. The main study was conducted from 23rd November, 2009 to 26th March, 2010. The study was temporarily put on hold because of a month holiday in all secondary schools within Calabar metropolis. Research team consisted of the lead author (carried out anterior and posterior segment examinations and refraction), ophthalmic nurse and ophthalmic assistant (carried out VA screening with Snellen's chart). Both the ophthalmic nurse and the ophthalmic assistant were recruited from the eye clinic of the University of Calabar Teaching Hospital.
Selected students were examined during break periods, free periods, soon after regular school hours or during afternoon classes. It took an average of 10 minutes to examine a student. First, the right eye was tested and then the left eye, both without [uncorrected visual acuity] and with [presenting visual acuity] spectacles, if the child brought them. Pin-hole and near chart readings were also carried out. A standard Snellen's 'E' chart from a distance of 6m was used to discourage memorization. Vision testing was down in well-lighted halls or on the corridors under normal daylight lighting if there was power failure. The 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. This was aimed at minimizing errors.
Anterior segment examination with pen torch and fundoscopy with a Welch Allyn (Welch-Allyn Inc., New York, USA) direct ophthalmoscope were carried out by the author. Students discovered to have ocular surface diseases like allergic conjunctivitis and posterior segment diseases

were referred to the University of Calabar Teaching Hospital using the prepared referral forms for the purpose. Students who had unaided visual acuity 6/9 in at least one eye were confirmed by the author and refracted with a Welch Allyn streak retinoscope (Welch-Allyn Inc., New York, USA) in a semi-darkened room in each school.

Refractions were carried out after all sampled students in each school were screened by VA and anterior and posterior segments examination concluded. Subjective refraction, using ¼ diopter Jackson Cross Cylinder for refinement of axis and power was done in all refracted students. The best corrected visual acuity was ascertained and recorded. Cycloplegic refraction was indicated in students in whom small pupils or excessive accommodation precluded satisfactory dry refraction. Pupils were dilated with 2 drops of 1% cyclopentolate (Alcon) combined with tropicamide 1% (ECWA Central Pharmacy Ltd, Jos), administered 5 minutes apart. After 20 minutes, light reflex and pupil dilation were evaluated after an additional 15 minutes. Cycloplegia was considered complete if the pupil dilated to 6 mm or greater and light reflex was absent. Fridays were chosen for cycloplegic refraction and Mondays for post-cycloplegic refraction to minimize the effects of dilated pupils on students' classroom learning.

Following refraction, students who could not be improved to 6/9 in either eye were considered to have pathology as the cause of reduced vision rather than refractive error in that eye. 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 tropias or phorias.

Criterion for failing vision screening

In the study a strict criterion was implemented. This was to cut false negatives to the barest minimum and to conform to several population-based studies3, 7, 8 that used VA of < 6/9 in either eye as the basis for refraction. Any student who had a visual acuity of worse than 6/9 in either eye was deemed to have failed the screening test. WHO recommended visual impairment of less than 6/18 in the better eye for studies on refractive errors.1 This may be unhelpful among secondary school students as a vision of 6/18 is already grossly sub-normal for this group.3 Nkanga et al1 reported that using visual acuity of less than 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%). This, therefore, informed the choice of 6/9 as cut-off for emmetropia in this study to allow for comparison of results with our study.

Data Management and Analysis

Data collected for this study was entered into a personal computer and analyzed using SPSS for Windows v.15.0 (SPSS Inc, Chicago, IL, 2008). Prevalence was calculated as the ratio of the number of individuals with a particular cause of visual impairment to the total number of screened students. Descriptive statistics included frequencies, mean and standard deviations. Exact binomial 95% CI was calculated for the prevalence estimate with Poisson distribution. Chi square test was used to observe the association of causes of visual impairment with respect to age and sex. P-value < 0.05 was considered statistically significant.

RESULTS

A total of 1,175 (94.7%; 1175/1241) were available for vision screening with Snellen's chart. Reasons for absenteeism included; withdrawal from the schools(7), transfers to other schools(28), inability to pay school fees(13), protracted illness(1) and relocation of parents (17). Of the screened students, there were 535 males and 640 females (45.5% and 54.5% respectively) with age range of 9-21 years. The mean age was 13.86+/-1.5 (95% Confidence Interval, [CI] = 13.35-14.36). The age and sex distribution of the study population is as shown in table 1. 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. Noteworthy, majority of students screened 1101 (93.7%; 1101/1175) were between the age bracket of 11 to 16 years.

One thousand and ninety four (93.1%; 1094/1421) with VA6/9 in both eyes (i.e. 6/9 in each eye tested separately) were considered emmetropic. In table 2 is shown the age distribution of visual acuity in all screened students. Eighty one (6.9%; 81/1175) of the students were found to have visual acuity worse than 6/9 in one or both eyes. Forty seven (58%; 47/81) were females and 34(42%; 34/81) were males. The observed gender disparity was not statistically significant (p = 0.174, one-tailed). Of the 81(6.9%) with VA 6/9 who meant the criterion for refraction, 61 (5.2%; 61/1175) were refracted to at least 6/9 in both eyes while the remaining 20(1.7%; 20/1175) had pathology as the cause of reduced vision. Refractive errors and presumed ocular toxoplasmosis were commonest causes of visual impairment. Of the 61 (51%) students with refractive errors, myopia, hypermetropia and astigmatism constituted 29.5%, 13.1% and 57.4% respectively. Other Causes of impaired vision are shown in figure 1.

The prevalence of visual impairment showed significant association with age (χ2=140.9, p=0.000, 95% Confidence interval [CI] = 0.000-0.055). No significant association was found between visual impairment and sex (χ2=16.4, p=0.086, 95% CI = 0.006-0.167). All p-values were one- tailed.

Table 1

Age and sex distribution of students (n = 1175)

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
Total	**535**	**45.5**	**640**	**54.5**	**1175**	**100**

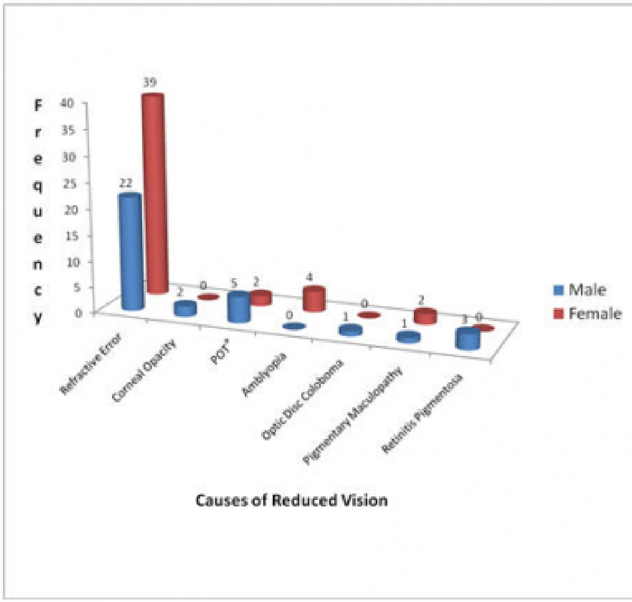
Table 2

Age distribution of VA in the better and worse eyes (n = 1175)

Better acuity	Age (years)					Total
	<10 n(%)	10<13 n(%)	13<16 n(%)	16<19 n(%)	≥19 n(%)	n
6/5-6/6	3(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)

Figure 1

Causes of impaired vision (n = 81)



*presumed ocular toxoplasmosis

DISCUSSION

In this study, the prevalence of visual impairment was found to be 6.9%. A similar study by Lian-Hong et al9 reported a comparable prevalence of 7.7%.There is paucity of reports on visual impairment among school-age children. Various studies on school children have focused on ocular diseases without emphasizing the impacts of such diseases on vision. Using a criterion of vision worse than 6/9, 81 (6.9%; 81/1175) of the students failed vision screening in the worse eye and 61(5.2%; 6/1175) in the better eye. Nkanga et al1 recorded markedly reduced value of 1.75% (n □ 34) in students with VA <6/9 in the better eye. Estimates of presenting VA □6/12 in the better eye ranged from 1.2% in South African Children aged 5-15 years10 up to 10.1% in Malaysian children aged 7-15 years.11 In India, Kalikivayi Y et al12 recorded about twice (12.5%) the value in this study when those with VA of 6/9 where included. These disparities could be due to variations in sampled population, study definitions and techniques of VA determination.
The commonest cause of visual impairment in the present study was refractive errors with a prevalence of 5.2%. Refractive error is one of the most common causes of visual impairment around the world13, 14 and the second leading cause of treatable blindness.15 Comparable prevalent figures have been reported in Nigerian school studies: Ilesha (5.8%)2, Enugu (7.4%)1 and Lagos (7.3%)16. A study from Ile-Ife, western-Nigeria, reported a much higher prevalence of (13.5%).17 This marked difference from other Nigerian studies could be attributable to study settings and working definitions. In other parts of Africa, Wedner et al8 and Ntim-Amponsah et al14 found a comparable prevalence of 5.6% and 7% respectively among secondary school students. Outside Africa, prevalence of refractive errors has been reported to range between 1.58-15% among school children. The prevalence recorded in this study falls within this range. Maul E et al18 and Zhao et al19 reported prevalence of 9.8% and 12.8% among 5-15% in old La Florida, Chile and Shunyi district, China respectively. In Nepal, Pokharel et al20 recorded 1.58%. Ethnicity, degree of urbanization of the schools, age and sex of the student population studied were different and could be responsible for the wide difference in prevalence of refractive errors found in these studies.
The reason for variable prevalence figures all over the world is multifactorial including the role of genetics in the determination of refractive errors which has been extensively documented.21, 22, 23 However, the association of gender with refractive error has not been well established. Some of the previous studies have shown that there are differences between biometric ocular parameters between men and women.24 Hence, there would be a correlation between gender and refractive error. But most studies found no difference of refractive errors between male and female groups.25, 26 Similarly, our study did not indicate a significant difference between males and females (p=0.174).
Posterior segment pathology was the second most common cause of sub-optimal vision in the current study. Presumed ocular toxoplasmosis (0.6%), retinitis pigmentosa (0.3%), non-specific macular pigmentary degenerations (0.3%) and optic disc coloboma (0.09%) where identified on direct fundoscopy. Adegbehingbe et al17 reported ocular toxoplasmosis prevalence of 0.8%, comparable to the finding in this study.
The contributions of anterior segment pathology to visual impairment was significantly low as corneal scarring were seen in only 2 (0.2%) of students. A similar low prevalent figure (0.3%; 3/1144) was reported by Ajaiyeoba et al2 in Ilesha, Nigeria. Perhaps due to the positive impact of immunization against measles and vitamin A distribution in Nigeria. This must have resulted in a decline in the prevalence of measles and vitamin A related keratopathy.
Controversy over which VA criteria should be adopted for the clinical definition of amblyopia and the population selected have caused differences in the prevalence of amblyopia.27, 28, 29 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. Reports30, 31, 32, 33, 34, 35 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 al31 reported 7.3%, Nigeria, Adegbehingbe et al17 22 reported 3.3% and Tanzania, Wedner et al30 reported 0.4%. Reports from Non-African countries also show varied prevalence figures in the order of 0.7%33, 1.7%34, 1.9%35 and 3.9%36. The study settings and definitions, the sampled population and location could account for the differences in these studies.
This study had some limitations. Firstly, the students who passed the vision screening test were neither examined nor refracted. Though this agreed with the methodology of most vision screening tests, nonetheless some symptomatic cases, especially those associated with reading and near work, could have been inadvertently left out. Secondly, some students who though fulfilled the inclusion criteria and were screened were not available for refraction on account of

truancy. Such unforeseeable circumstances are not unexpected in our environment.

Despite these limitations, it is strongly believed that the population-based sample, the high participation rate (94.7%) and the meticulous refraction and examination protocol allowed for the realization of the study objectives.

In conclusion, the authors found that 6.9% students had subnormal vision with substantial percentage caused by refractive errors. The use of school teachers for the purposes of vision screening has been advocated. It is suggested that school health programs be established where teachers are trained to do visual acuity of their students using Snellen's chart. This is to identify students with sub-optimal vision and refer to centers with refractive services. Non-governmental and voluntary organizations can help establish optical workshops in major eye hospitals where corrective lenses will be provided at affordable prices for students. Incorporation of eye health education and promotion into school health program among secondary school students will re-orientate them and place correction of refractive errors in its proper perspective.

ACKNOWLEDGEMENTS

The authors wish to thank the school principals, teachers, the students and parents for consents and cooperation. The permission of the Cross River State Commissioner of Education through the Education Ministry is being acknowledged.

References

1. Nkanga DO, Dolin P. School Vision Screening Programme in Enugu, Nigeria: Assessment of referral criteria for error of refraction. Nig J Ophthalmol 1997; 5(1): 34-40
2. Ajaiyeoba Al, Isawumi MA, Adeoye AO, Oluleye TS. Prevalence and causes of blindness and visual impairment among school children in south-western Nigeria. Ann Afr Med 2006; 4: 197-203.
3. Adegbehingbe BO, Oladehinde MK, Majengbasan TO, Onakpoya HO and Osagiede EO. Ocular morbidity in secondary school students in Ile-Ife, Osun state, Nigeria. Nig J Ophthalmol 2006; 14(2): 60-63.
4. Stewart-Brown SL, Haslum M. Screening of vision in school: could we do better by doing less? BMJ 1988; 297:1111-3.
5. Gerry J, Barnaby R, Kate S, Barbara C. The effectiveness of vision screening by school nurses in secondary school. Arch Dis Child 1994; 70: 14-18.
6. IOM: Evolution of school health programs. In School & health: Our nation's investment. Edited by Allensworth D, Lawson E, Nicholson L, Wyche J. Washington, DC: National Academy Press; 1997:33-80.
7. Chuka-Okosa MC. Refractive errors among students of a post-primary institution in rural community in South-Eastern Nigeria. West Afr J Med 2005; 24(1): 62-65.
8. Wedner SH, Ross DA, Todd J, Anemona A, Baliva R et al. Myopia in secondary school students in Mwanza city, Tanzania: the need for a national screening programme. Br J Ophthalmol 2002; 86: 1200-1206.
9. Lian-Hong P, Lin C, Qin L, Ning K, Jing F, Shu Z et al. Prevalence of Eye Diseases and Causes of Visual Impairment in School-Aged Children in Western China. J Epidemiol 2012; 22: 37-44.
10. Naidoo KS, Raghunandan A, Mashie KP. Refractive error and visual impairment in Africans. Invest Ophthalmol Vis Sci 2003; 44: 3764-3770.
11. Goh PP, Abgariyah Y, Pokharel GP, Ellwein LB. Refractive error and visual
Impairment in school-age children in Gombak District, Malaysia. Ophthalmology
2005; 112: 678-685.
12. Kalikivayi V, Naduvillalh TI, Bansal AK, Dandona L. Visual Impairment in school children in Southern India. Ind J Ophthalmol 1997; 45: 129-134.
13. Adegbehingbe BO, Oladehinde MK, Majengbasan TO, Onakpoya HO, Osagiede EO. Screening of Adolescents for Eye Diseases in Nigerian high schools. Ghana Med J 2005; 39: 138-142.
14. Ntim-Amponsah CT, Ofosu-Amaah S. Prevalence of Refractive Error and other Eye Diseases in Schoolchildren in the Greater Accra Region of Ghana. J pediatr Ophthalmol strabismus 2007; 44(5): 294- 297.
15. Dandona R, Dandona L. Refractive error blindness. Bull World Health Organ. 2001; 79:237–243.
16. Faderin MA, Ajaiyeoba Al. Refractive errors in primary school children in Nigeria. Nig J Ophthalmol 2001; 9(1): 10-13.
17. Adegbehingbe BO, Oladehinde MK, Majengbasan TO, Onakpoya HO, Osagiede EO. Screening of Adolescents for Eye Diseases in Nigerian high schools. Ghana Med J 2005; 39: 138-142.
18. Maul E, Barroso S, Munoz SR, Sperduto RD, Ellwein LB. Refractive error study in Children: results from La Florida, Chile. Am J Ophthalmol 2000; 129: 445-454.
19. Zhao J, Pan X, Sui R, Munoz SR, Ellwein LB et al. Refractive error study in Children: results from Shunyi District, China. Am J Ophthalmol 2000; 129: 427-435.
20. Pokharel GP, Negrel AD, Munoz SR, Ellwein LB. Refractive error study in Children: results from Shunyi District, China. Am J Ophthalmol 2000; 129: 436-444.
21. Montés-Micó R, Ferrer-Blasco T. Distribution of refractive errors in Spain. Doc Ophthalmol. 2000; 101: 25-33.
22. Young TL, Metlapally R; Shay AE. Complex Trait Genetics of Refractive Error. Arch Ophthalmol 2007; 125: 38-48.
23. Biio G, Corona C. Ocular refraction: Heritability and Genome-wide search for eye
morphometry traits in an isolated Sardinian population. Hum Genet 2005; 116:152-159.
24. Ferrer-Blasco T, González-Méijome JM, Montés-Micó R. Age-related changes in the human visual system and prevalence of refractive conditions in patients attending an eye clinic. J Cataract Refract Surg. 2008; 34: 424-432.
25. Wong TY, Foster PJ, Ng TP, Tielsch JM, Johnson GJ, Seah SK. Variations in ocular biometry in an adult Chinese population in Singapore: The Tanjong Pagar survey. Invest Ophthalmol Vis Sci. 2001; 42: 73-80.
26. Katz J, Tielsch JM, Sommer A. Prevalence and risk factors for refractive errors in an adult inner city population. Invest Ophthalmol Vis Sci. 1997; 38: 334-340.
27. Audrey C, Mohamed D, Yiong-Huak C, Gus G, Kah-Guan A E, Prabakaran S. Prevalence of Amblyopia and

Strabismus in Young Singaporean Chinese Children. Invest. Ophthalmol. Vis. Sci. 2010: 51(7); 3411-3417.
28. Simons K. Amblyopia characterization, treatment, and prophylaxis. Surv Ophthalmol 2005; 50: 123– 166.
29. Sadia SH, Mohammad JS, Naimatullah KK. Causes of amblyopia in children coming to ophthalmology outpatient department Khyber Teaching Hospital, Peshawar. J Pak Med Ass 2008; 58: 125-128.
30. Wedner SH, Ross DA, Todd J, Anemona A, Baliva R et al. Myopia in secondary school students in Mwanza city, Tanzania: the need for a national screening programme. Br J Ophthalmol 2002; 86: 1200-1206.
31. Naidoo KS, Raghunanadan A, Mashige K, et al. Refractive error and visual impairment in African children in South Africa. Invest Ohthalmol Vis Sci. 2003; 44: 374–380.
32. Adegbehingbe BO, Oladehinde MK, Majengbasan TO, Onakpoya HO, Osagiede EO. Screening of Adolescents for Eye Diseases in Nigerian high schools. Ghana Med J 2005; 39: 138-142.
33. Robaei D, Rose KA, Ojaimi E, Kifley A, Martin FJ, Mitchell P. Causes and association of amblyopia in a population-based sample of 6-year old Australian children. Arch Ophthalmol 2006; 24(6): 878-884.
34. Jamali P, Fotouhi, Hashemi H, Younesian M, Jafari A. Refractive Errors and Amblyopia in Children Entering School: Shahrood, Iran. Optom Visc Sci 2009; 84(4): 364-369.
35. He M, Zeng J, Liu Y, Pokharel GP, Ellwein LB. Refractive errors and visual impairment in urban children in southern China. Invest Ophthalmol 2004; 45(3): 793-799.
36. Lyhne N, Sjolie AK, Kyrik KO, Green O. The Importance of Genes and Environment on Ocular Refraction and its Determinants: A Population-based Study among 20-45 years old twins. Br J Ophthalmol 2001; 85:1470-1476.

Author Information

Olu Emmanuel MEGBELAYIN, MBBS, FMCOphth,
University of Uyo Teaching Hospital
Akwa-Ibom State, Nigeria
favouredolu@yahoo.com

Edet Uduak ASANA, MBBS, FMCOphth, FWACS,
University of Calabar Teaching Hospital
Cross River State, Nigeria