African Vision and Eye Health
ISSN: (Online) 2410-1516, (Print) 2413-3183

Visual status and prevalence of eye disorders among school-age children in southern Nigeria

Authors:
Bernadine N. Ekpenyong[1]
Kovin Naidoo[2]
Kelechukwu Ahaiwe[3]
Onyeka Ezenwankwo[4]
Onyebuchi Ndukwe[3]
Emmanuel Ogar[5]
Ekanem Ekanem[6]

Affiliations:
[1]Department of Public Health, University of Calabar, Nigeria

[2]International Agency for Prevention of Blindness (Africa) – Public Health, Brien Holden Vision Institute, South Africa

[3]Teaching Hospital, University of Calabar, Nigeria

[4]Optometrist Benita Eye Clinic, Calabar, Nigeria

[5]General Hospital Ogoja, Cross River State, Nigeria

[6]Department of Community Health, University of Lagos, Nigeria

Corresponding author:
Bernadine Ekpenyong,
benyita2001@yahoo.com

Dates:
Received: 13 Oct. 2016
Accepted: 30 Mar. 2017
Published: 27 June 2017

How to cite this article:
Ekpenyong BN, Naidoo K, Ahaiwe K, et al. Visual status and prevalence of eye disorders among school-age children in southern Nigeria. Afr Vision Eye Health. 2017;76(1), a377. https://doi.org/10.4102/aveh.v76i1.377

Aim: This study assessed the types and prevalence of eye problems among school-age children in Cross River State (CRS), Nigeria.

Method: The study design was a cross-sectional analytic survey of 2418 school children aged 6–17 years from seven public and three private schools in CRS, selected using the multistage random sampling technique. Ethical approval was obtained from the Ethical Committee, CRS Ministry of Health, Nigeria. The following tests were carried out on all children enrolled in the study: researcher-administered semi-structured questionnaires, LogMAR visual acuity measurements, external and internal eye examinations, non-cycloplegic auto-refractions, retinoscopy and subjective refractions. Quality assurance was carried out to validate the data collected, and data were analysed using SPSS and EPI info.

Results: A total of 2418 school children were enumerated, and 2110 (87.3%) were examined; 1117 (52.9%) were girls, and 1250 (59.2%) were 6–11 years old, while 860 (40.8%) were 12–17 years old, and 77% attended public schools. The majority, 1895 (89.9%) of the children examined, had never had an eye examination. The prevalence of eye diseases among the school children was 32.1%, and the major causes were conjunctivitis 397 (18.8%; confidence interval [CI] 19.2–13.0), refractive error 243 (11.5%; CI 10.2–13.0), glaucoma suspects 52 (2.5%; CI 1.9–3.2), amblyopia 7 (0.3%; CI 0.0–0.7) and corneal opacity 4 (0.2%; CI 0.1–0.5). Analysis using chi-square tests and logistic regression shows a positive higher association of refractive error in private (16.7%) than public schools (9.9%) (crude odds ratio [COR] 1.8150; adjusted odds ratio [AOR] 1.9129, $p < 0.001$), higher socio-economic status of parents (COR 2.3402, AOR 1.9819, $p < 0.001$), older age group (COR 1.7258, AOR 1.8202, $p < 0.001$) and girls (13.1%) versus boys (9.8%) (COR 0.7200, AOR 0.7144, $p < 0.001$).

Conclusion: Physical and eye health examination of children before school entry is strongly recommended. The application of 2 D lens for children who fail a standard visual acuity test should be routine during vision screening to ensure that significant refractive errors are not missed.

Introduction

It is estimated that of the world's 285 million people with visual impairment[1], 19 million are children.[2] Although this number is smaller when compared with the adult visual impairment population, the number of years the children potentially may live with their visual impairment has devastating effects. Research has also shown that 'children who become blind may die within one year of becoming blind and they also have higher mortality rates than their sighted counterparts'.[3] Most of the serious ocular disorders which occur in children, if undetected and untreated, progress over years and can result in lifetime blindness and 'nearly 50% of the causes of the blindness in children are avoidable'.[2] The causes vary widely according to 'socio-economic development, eye care services and availability of primary health care'.[2] The high prevalence of measles and vitamin A deficiency in low-income countries are reasons for the high magnitude of avoidable childhood blindness when compared with middle- and high-income countries.[4]

School surveys and hospital-based studies on the distribution of eye conditions and diseases have indicated that conjunctivitis, refractive errors, corneal scarring and injuries are some of the major eye conditions affecting Nigerian children.[5,6,7,8,9,10] The prevalence of blindness across all age groups in Cross River State (CRS) in Nigeria, according to the report of the state population-based survey on blindness and visual impairment in 2006, was 0.8%, and 'the major causes of blindness, defined as presenting visual acuity of less than 3/60, were refractive error,

glaucoma and cataract'.[11] 'Avoidable blindness and low vision can restrict progress in education, particularly literacy and limited motor development in children and limit mobility and access to information'.[12] This indeed is disturbing in view of the subsequent emotional and socio-economic consequences of the condition on the child, family, community and the nation at large. The number of school children with vision problems will continue to increase if significant interventions are not undertaken.

It is, therefore, necessary that epidemiological studies are conducted in CRS, southern Nigeria, to identify the seriousness of eye problems in school-age children and their risk factors for better school eye health service planning, which ultimately may lead to reduction in the magnitude of avoidable visual impairment in school children. This is necessary for the achievement of the Global Eye Health Action Plan (GAP) 'target of reduction in prevalence of avoidable visual impairment by 25% by 2019'.[13]

Methodology

Cross River State is one of the 36 states in Nigeria, located in the southern part of the country. The CRS consists of three health zones with six geographical districts each called a local government area (LGA). The sample size of children, age 6–17 years, used for the study was 2418. One LGA was selected per zone by simple random sampling technique, and schools were stratified into public, private, primary and secondary schools. The population of each school selected was determined from the school register through the school head. The total population of all the selected schools came to 7922, which was used to determine the number of children selected for the study per school using a simple proportion (school population/total population × sample size). Thus, the number of children selected per school was proportionate to the school population.

In each of the schools selected, the total number of children to be selected was divided by the number of class levels, which were usually six for both primary and secondary schools. The sampling frame used for the selection of children was a listing of class-based clusters within each school with the number of children in each. Only children who met the inclusion criteria were selected until the total required number was achieved per class level using the systematic sampling procedure. Written consents were obtained from the parents, and verbal consents were also obtained from all children before obtaining data with interviewer-administered semi-structured questionnaires and clinical examination.

Data collection including clinical examinations was done by six optometrists, two ophthalmic nurses and the lead researcher. The following assessments were carried out on every child selected for study irrespective of visual acuity status: visual acuity tests at distance and near using a LogMAR chart with tumbling E optotypes, ophthalmoscopy, objective and subjective refractions without cycloplegia, autorefraction and retinoscopy with trial lenses. The fogging technique was used in place of cycloplegic refraction to achieve additional relaxation of accommodation.[14] Significant refractive error was defined as myopia of $\geq |-0.50\ D|$, hyperopia of ≥ 1.50 D and astigmatism of $\geq |-0.75\ D|$. Diagnosis was determined based on anatomical and aetiological considerations. Conjunctivitis was defined as conjunctival injection, brownish colouration with or without circumlimbal follicles and recurrent itching.

Data analysis

Data were entered and cleaned using the IBM SPSS (Version 20) software. For statistical analysis, EPI Info 3.5.4 and IBM SPSS were used depending on the specific analysis. Associations between categorical variables in contingency tables were evaluated with the chi-square statistic. The unconditional logistic regression analysis was used to examine the relationship between independent variables and the occurrence of visual problems while controlling for potential confounders. Associations in which *p*-values were 0.05 or less were considered statistically significant. For quality assurance, strength of agreement between the measurements made by the researcher and the research assistants was evaluated using Cohen's kappa statistic and paired *t*-tests.

Quality assurance for reliability of data collected

Out of the 10 schools used for the study, four schools were selected by simple random sampling for quality assurance. A total of 106 (5% of 2110) of the previously examined children were enumerated for quality assurance, out of which 105 were re-examined to test for reliability of data collected. Visual acuity was obtained in 105 of the children subjected to quality assurance, and results were analysed to compare if there was a significant difference between the two sets of results. For the right eye, 94 out of 105 had line-by-line agreement of visual acuity, whereas the rest varied by one or two lines. For the left eye, 96 measurements were in agreement, whereas nine varied by one or two lines. Using a paired *t*-test, test–retest differences were not significant at 95% ($p > 0.05$) and the *t*-value was very close to zero. For both right and left eyes, the 95% upper and lower limits of agreement around the mean difference were -0.0019–0.0153 for right eyes and -0.0186–0.0186 (0.00 ± 0.96) for left eyes.

Results

The total enrolment of school children in the 10 selected schools for the study was 7922, and the calculated sample size for the cross-sectional study was 2418. Out of 2418 school-age children enumerated for this study, eventually 2110 were examined, which gave a response rate of 87%. Some of the children enrolled for the study were not available for examination because their parents collected them immediately after school. Of the 2110 children in the study, 1117 (52.9%) were girls, 1250 (59.2%) were aged 6–11 years,

860 (40.8%) were aged 12–17 years, and the mean age of all children was 11.69 ± 3 years. About 1612 (76.4%) children attend public school. Distribution of the children's enrolment for the study by school location in terms of Zones and LGAs shows that Calabar South LGA (South Zone), Etung LGA (Central Zone) and Ogoja LGA (North Zone) has 942 (44.6%), 419 (19.6%) and 749 (35.5%) children enrolled, respectively (Table 1).

Results show that 31.2% of school children examined had visual problems. The major visual problems among school-age children varied according to age, gender, school type and socio-economic status (SES) of parents. The prevalence of conjunctivitis, mostly allergic or vernal, among 993 school-age boys in this study was 237 (23.9%), whereas the prevalence among 1117 girls was 160 (14.3%). Analysis using chi-square test statistics shows a significant difference in the prevalence of conjunctivitis between the boys and the girls ($p < 0.001$). However, refractive error was higher among the girls 146 (13.1%) than the boys 97 (9.8%); this result was analysed using a chi-square test, and the difference was significant at a 95% confidence level ($p = 0.017$). Retinal anomalies were also found to be almost significant among the girls (0.4%) rather than the boys where nobody presented with retinal anomaly ($p = 0.06$). The prevalence of the other types of visual problems among the school children was not significant (95%, $p > 0.05$, [Table 2]).

A total of 160 (9.9%) children in public schools had refractive error, whereas 83 (16.7%) children in private schools had refractive error. Analysis using the chi-square test showed that the prevalence of refractive error was significantly higher among children in private schools than those in public schools ($p < 0.001$). Likewise, the prevalence of conjunctivitis among children in public schools was 327 (20.3%), whereas it was 70 (14.1%) among those in private schools. Thus, conjunctivitis was significantly higher among children in public than private schools ($p < 0.001$). There was no significant difference found in the occurrence of the other identified eye conditions. However, glaucoma suspects were marginally higher among those in private schools 18 (3.6%) than public schools (43 [2.1%], $p = 0.06$, Table 3).

The association between the prevalence of eye conditions among the school-age children within the age group of 6–11 years and those within the age group 12–17 years was tested using a chi-square test and logistic regression. The result indicated the prevalence of refractive error 128 (14.8%) among the children aged 12–17 years was significantly higher than 115 (9.2%) among the children aged 6–11 years in primary schools ($p < 0.001$). The prevalence of retinal

TABLE 1: Demographic characteristics and description of school children in the study.

Characteristics	Frequency (n = 2110)	Percentage
Gender		
Boys	993	47.1
Girls	1117	52.9
Age (in years)		
6–11 (primary)	1250	59.2
12–17 (secondary)	860	40.0
Religion		
Christianity	2095	99.3
Islam	14	0.7
Traditional	1	0.0
School location		
South	942	44.6
Central	419	19.6
North	749	35.5
School type		
Public	1612	76.4
Private	498	23.6

TABLE 3: Prevalence of eye diseases among children in public and private schools.

Eye diseases	Number %				p-value
	Public (n = 1612)		Private (n = 498)		
	n	%	n	%	
Conjunctivitis	327	20.3	70	14.1	0.001
Refractive error	160	9.9	83	16.7	< 0.001
Amblyopia	5	0.3	2	0.4	0.756
Glaucoma suspect	34	2.1	18	3.6	0.058
Corneal opacity	4	0.2	0	0.0	0.265†
Retinal anomaly	4	0.2	0	0.0	0.265†
Albinism/nystagmus	1	0.1	1	0.2	0.379†
Cataract	1	0.1	0	0.0	0.578†
Others	9	0.6	4	0.8	0.541†

Analysis based on chi-square.
†, Fishers Exact test.

TABLE 2: Distribution of eye diseases among school children by gender.

Eye diseases	Number %				Total %		95% CI	p-value
	Boys (n = 993)		Girls (n = 1117)					
	n	%	n	%	n	%		
Conjunctivitis	237	23.9	160	14.3	397	18.8	17.2–20.6	< 0.001
Refractive error	97	9.8	146	13.1	243	11.5	10.2–13.0	0.017
Glaucoma suspect	30	3.0	22	2.0	52	2.5	1.9–3.2	0.119
Amblyopia	3	0.3	4	0.4	7	0.3	0.0–0.7	0.823
Corneal opacity	2	0.2	2	0.2	4	0.2	0.1–0.5	0.906
Retinal anomaly	0	0.0	4	0.4	4	0.2	0.1–0.5	0.059
Albinism/nystagmus	1	0.1	1	0.1	2	0.1	0.0–0.4	0.933
Cataract	0	0.0	1	0.1	1	0.0	0.0–0.3	0.345
Others	6	0.6	7	0.6	13	0.6	0.3–1.1	0.947

Analysis based on chi-square and Fishers Exact test.
Others – blepharitis, squint, style, phthitis bulbi.

anomalies was also seen to be significantly higher in children in the older age group (p = 0.015), whereas there was no significant difference found in the prevalence of the other eye conditions (Table 4).

The SES of parents or guardians of the children examined was computed into high, medium and low using the educational levels and occupation of parents. Univariate analysis using chi-square showed that the prevalence of eye disease among school children varied with SES. Refractive error prevalence among the high SES 46 (14.8%), medium SES 139 (14.7%) and low SES 58 (6.8%) varied significantly (p < 0.001). Another condition that varied significantly was retinal anomalies, and its prevalence was 2 (0.6%), 0 (0.0%) and 1 (0.1%) for high, medium and low SES, respectively, with (p = 0.031) (Table 5).

TABLE 4: Prevalence of eye diseases among primary (6–11 years) and secondary (12–17 years) school children.

Eye diseases	Number %				p-value
	Primary (6–11 years) (n = 1250)		Secondary (12–17 years) (n = 860)		
	n	%	n	%	
Conjunctivitis	238	19.0	159	18.5	0.750
Refractive error	115	9.2	128	14.9	< 0.001
Glaucoma suspect	28	2.2	24	2.8	0.422
Amblyopia	3	0.2	4	0.5	0.376
Corneal opacity	3	0.2	1	0.1	0.520†
Retinal anomaly	0	0.0	4	0.5	0.015†
Cataract	0	0.0	1	0.1	0.227†
Albinism/nystagmus	1	0.1	1	0.1	0.790†
Others	8	0.6	5	0.6	0.865†

Analysis based on chi-square.
†, Fishers Exact test.

The SES of parents and the prevalence of eye diseases were further analysed using multiple logistic regression. The variables that were significantly associated with refractive error were age group, SES, school type and sex. Children aged 12–17 years were almost two times more likely to have refractive error than those aged 6–11 years. Children whose parents were within the medium SES group, were about two times more likely to have refractive errors than those in the low SES level. Those whose parents are in the high SES level were also two times more likely to have refractive than those in low SES. Thus, the risk of refractive error was significantly associated with SES. Children in private schools were more likely than those in the public schools to have refractive error (p < 0.001, Tables 6 and 7).

Discussion

To determine the eye health state of school-age children and the delivery of school eye health services in CRS, a total number of 2110 children aged 6–17 years were examined. The age distribution of the children enumerated was nearly uniform except for the 11-year-olds, who were relatively high in number due to the desire of the children who were 12 years in the primary level to also be part of the study. They, therefore, presented themselves as 11-year-olds rather than as 12-year-olds. This scenario was different from that in South Africa where children overstated their age to be excluded.[15]

TABLE 5: Prevalence of eye diseases by socio-economic status of parents.

Eye diseases	High (n = 310)		Medium (n = 947)		Low (n = 847)		p-value
	n	%	n	%	n	%	
Refractive error	46	14.8	139	14.7	58	6.8	< 0.001
Conjunctivitis	50	16.1	187	19.7	158	18.7	0.364
Glaucoma suspect	7	2.3	23	2.4	22	2.6	0.941
Amblyopia	3	1.0	3	0.3	1	0.10	0.084
Retina anomaly	2	0.6	0	0.0	1	0.1	0.031
Cataract	0	0.0	2	0.6	1	0.1	0.673
Corneal opacity	0	0.0	3	0.3	2	0.2	0.610
Albinism/nystagmus	1	0.3	1	0.1	0	0.0	0.285
Others	0	0.0	7	0.7	5	0.6	0.323

Analysis based on Chi-square and Fishers Exact test.

TABLE 6: Logistic regression analysis of the relationship between age group, socio-economic status, school type, gender and prevalence of refractive error.

Variable	Crude odds ratio	Adjusted odds ratio	95% CI	Coefficient	Z-statistic	p-value
Age group†						
6–11	-	-	-	-	-	-
12–17	1.726	1.820	1.364–2.429	0.599	4.070	< 0.001
SES						
Low‡	1.00	-	-	-	-	1.000
Medium	2.340	1.982	1.423–2.760	0.684	4.050	0.001
High	2.370	1.879	1.230–2.871	0.631	2.916	0.004
School type§						
Public	1.00	-	-	-	-	1.000
Private	1.815	1.913	1.402–2.611	0.649	4.087	< 0.001
Gender¶	1.00					
Boy	0.720	0.714	0.541–0.943	0.943	-2.379	0.017

SES, socio-economic status.
†, 6–11 years = reference; ‡, Low = reference; §, Public = reference; ¶, Girl = reference.

TABLE 7: Logistic regression analysis of the relationship between age group, socio-economic status, school type, gender and prevalence of conjunctivitis.

Variable	Crude odds ratio	Adjusted odds ratio	95% CI	Coefficient	*Z*-statistic	*p*
Age group†						
6–11 years	-	-	-	-	-	-
12–17 years	1.037	0.924	0.731–1.168	-0.079	-0.663	0.506
SES						
Low‡	-	-	-	-	-	-
Medium	1.073	1.161	0.909–1.483	0.149	1.192	0.233
High	0.839	0.935	0.653–1.340	-0.067	-0.364	0.716
School type§						
Public	-	-	-	-	-	-
Private	0.643	0.603	0.449–0.811	-0.505	-3.354	0.008
Gender¶						
Boy	1.875	1.894	1.514–2.369	0.639	5.589	< 0.001

SES, socio-economic status.

†, 6–11 years = reference; ‡, Low = reference; §, Public = reference; ¶, Girl = reference.

Also the non-use of cycloplegia, while a limitation, might have increased participation. But the fogging technique as used herein has been reported in previous studies.[16]

The results of this study showed that 32.1% of the children examined had eye problems, this finding being higher than the results in other studies within Nigeria. In Anambra, a 6.1% prevalence in eye diseases was found among school children,[10] whereas in a similar study carried out in the northern part of Nigeria, 22.6% was reported as the prevalence of ocular disorder among children who participated in the school eye screening.[5] In Osun State, Ayanniyi et al. reported 19.9%[9], whereas Ajaiyeoba et al. (2007) found 15.5%.[7] The higher prevalence of eye diseases in this study could be due to the fact that all children were refracted and examined irrespective of visual acuity; this made it possible for more people with hyperopia and other refractive errors to be diagnosed who were usually excluded using a cut-off visual acuity as is commonly done in some studies and school vision programmes. A study in India, however, found the prevalence of eye diseases among children to be 31.6%,[17] which is similar to the findings of this study. A Tanzanian study found 15.6% prevalence of ocular morbidity.[18] Differences in methodologies also could account for some of the differences.

The most common ocular or visual problems found were allergic or vernal conjunctivitis (18.8%), refractive error (11.5%), glaucoma suspect (2.5%) and amblyopia (0.3%). Allergic or vernal conjunctivitis was the most common surface disorder found in children, accounting for 18.8% of school children examined. However, chronic allergic conjunctivitis was found more among school children in the northern part of CRS, where the dusty and hot environment may be the contributing factors. Other studies also reported conjunctivitis as the most common eye diseases among school children but the prevalence varied with the result of this study. The difference could be due to differences in study settings and seasonal variability. 'The prevalence of conjunctivitis in a similar study by Okoye et al.[10] was 48%, whereas Onakpona and Adeoye[19] found 17.8%'. But, lower percentages of 8% and 6.7%, respectively, were found by Ajaiyeoba et al.[7] and Ayanniyi et al.[9] In China and India, prevalence was as low as 0.65%[20] and 0.8%,[17] respectively.

Further analysis revealed that conjunctivitis was more prevalent among the boys and also among children inpublic rather than private schools ($p < 0.01$). Conjunctivitis was seen more among children aged 6–11 years than those aged 12–17 years, but the difference was not significant ($p = 0.750$). The prevalence of conjunctivitis as reported by Gupta et al. was significantly more among government school children as compared to children in private schools.[17] The reason for this difference in the prevalence of conjunctivitis perhaps could be linked to SES of parents, which is generally higher for those in private schools, and possibly their children might find it generally easier to maintain good hygiene.

Refractive error is a major eye condition in children, and in this study, it was found to be prevalent in 11.5% (95% confidence interval [CI] 10.2–13.0) of all children examined without cycloplegia, but with fogging instead. Analysis using chi-square test statistics and logistic regression showed that refractive error among school children significantly varied with gender, age group, school type and SES of parents or guardians of the children. Significantly, the prevalence of refractive error was higher among the girls than the boys ($p < 0.01$), and this could be due to the fact that girls were more involved in activities that require near work such as reading and doing house chores than the boys or could be due the fact that the girls engage in less outdoor activities than the boys.

This result is similar to the studies carried out within and outside Nigeria, but the prevalence of refractive error varied by magnitude; Okoye et al.[10] found 11%, among primary school children, Onakpoya and Adeoye[19] found 14.4%, Ajaiyeola[7] found 5.8% and Abah et al.[5] found 8%. The difference in prevalence could be due to differences in age groups and the fact that the prevalence of refractive errors increases with age. The variation in visual acuity cut-off, definition of refractive errors and study area may also contribute to the observed differences. Reviews of international studies revealed a higher prevalence of refractive error.[17,21] Perhaps differences in economic status of countries could be responsible for the variation.

The results of this study have shown that highly significant differences exist between the prevalence of eye diseases and SES of parents of the children ($p < 0.001$). When adjusted for

other risk factors, the positive association between refractive error and higher SES was still significant. Children whose parents are of high SES were more likely than those with low SES to have refractive error, and those whose parents are in the middle class were also more likely than those in the lower SES to have refractive errors. This finding is closely linked with the results of the analysis on the association between the prevalence of refractive error and school type, which revealed that those in private schools were two times more likely than those in the public schools to have refractive error ($p < 0.001$). This is so because private schools have higher fees and so children of high- and medium-income families are usually enrolled in them compared to public schools with very low or sometimes no fees structure and usually belong to the lower SES. This finding is in agreement with a similar study carried out in Calabar Municipality among secondary school children in public and private schools, refractive error was significantly more among secondary school children from high socio-economic background.[22] Higher prevalence of refractive error among children in private schools has also been reported in other international studies.[17,23]

Conclusion

This research has revealed that nearly 90% of the children examined had their first eye examination during this study. The common eye disorders among school-age children were refractive error, conjunctivitis (mainly allergic), amblyopia and corneal opacity. Univariate and multivariate analysis indicated that the eye conditions of the school children significantly varied with age, gender, school type and SES of parents. Children aged 12–17 years significantly had more refractive error than those aged 6–11 years; thus, emphasis could be placed on this age group during planning for school eye care programmes especially when there are insufficient resources. Eye problems among school children are common, and in the absence of school vision screening, many children with visual problems will go undetected. Reduction in the prevalence of avoidable causes of blindness and visual impairment in school-age children can be achieved through enabling policy, commitment of all stakeholders and the establishment of eye care that is integrated into comprehensive and coordinated school health programmes.

Acknowledgements

The authors thank the African Vision and Research Institute for financial assistance with publishing page fees.

Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

B.N.E. was the lead researcher who conceptualised and coordinated the research. K.N. supervised and gave the research direction. K.A., O.E., O.N. and E.O. were involved in data collection. E.E. provided professional supervision and guidelines and also assisted in the research analysis.

References

1. Pascolini D, Mariotti SP. Global estimates of visual impairment: 2010. Br J Ophthalmol. 2012;96(5):614–618.
2. Gilbert C, Foster A. Childhood blindness in the context of VISION 2020 – The right to sight. Bull World Health Organ. 2001;79(3):227–232.
3. Gilbert C, Awan H. Blindness in children: Half of it is avoidable, and suitable cost effective interventions are available. Br Med J. 2003;327:760–761. https://doi.org/10.1136/bmj.327.7418.760
4. Koay CL, Patel DK, Tajunisah I, Subrayan V, Lansingh VC. A comparative analysis of avoidable causes of childhood blindness in Malaysia with low income, middle income and high income countries. Int Ophthalmol. 2015;35(2):201–207. https://doi.org/10.1007/s10792-014-9932-x
5. Abah ER, Oladigbolu KK, Samaila E, Gani-Ikilama A. Ocular disorders in children in Zaria children's school. Niger J Clin Pract. 2011;14(4):473–476. https://doi.org/10.4103/1119-3077.91759
6. Abiose A, Bhar IS, Allanson MA. The ocular health status of postprimary school children in Kaduna, Nigeria: Report of a survey. J Pediatr Ophthalmol Strabismus [serial on the Internet]. 1980 [cited 2015 Jan 15];17(5):337–340. Available from: http://www.ncbi.nlm.nih.gov/pubmed/7441448
7. Ajaiyeoba AI, Isawumi MA, Adeoye AO, Oluleye TS. Prevalence and causes of blindness and visual impairment among school children in south-western Nigeria. Int Ophthalmol. 2007;26(4–5):121–125. https://doi.org/10.1007/s10792-005-4836-4
8. Ajaiyeoba A. Childhood eye diseases in Ibadan. Afr J Med Med Sci [serial on the Internet]. 1994 [cited 2015 Feb 03];23:227–231. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=7604746
9. Ayanniyi AA, Mahmoud AO, Olatunji FO. Causes and prevalence of ocular morbidity among primary school children in Ilorin, Nigeria. Niger J Clin Pract. 2010;13(3):248–253.
10. Okoye O, Umeh RE, Ezepue FU. Prevalence of eye diseases among school children in a rural south-eastern Nigerian community. Rural Remote Health [serial on the Internet]. 2013[cited 2015 Jan 15];13(3):2357. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24093438
11. Nkanga DG, Asana UE, Duke R, Ekpenyong BN, Etim BA. Causes of visual impairment and blindness in Cross River State Nigeria: A population based survey. Paper presented at: World Congress on Refractive Error; South Africa; 2007 March 14–16.
12. Holden BA, Sulaiman S, Knox K. The challenge of providing spectacles in the developing world. Community Eye Health [serial on the Internet]. 2000[cited 2015 March 30];13(33):9–10. Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1705961&tool=pmcentrez&rendertype=abstract
13. IAPB. Prevention of Blindness and Visual Impairment Universal Eye Health : A global action plan. 2015; p. 1–19. Available from: http://www.who.int/blindness/actionplan/en/index1.html
14. Queiros A, Gonzalez-Meijome, Jorge J. Influence of fogging lenses and cycloplegia on open field automatic refraction. Ophthalmic Physiol Opt. 2008;29(4):387–392. https://doi.org/10.1111/j.1475-1313.2008.00579.x
15. Naidoo KS. Refractive error and visual impairment in African children in South Africa. Invest Ophthalmol Vis Sci. 2003;44(9):3764–3770. https://doi.org/10.1167/iovs.03-0283
16. Ovenseri-Ogbomo GO, Assien R. Refractive error in school children in Agona Swedru, Ghana. S Afr J Optom. 2010;69(2):86–92. https://doi.org/10.4102/aveh.v69i2.129
17. Gupta M, Gupta BP, Chauhan A, Bhardwaj A. Ocular morbidity prevalence among school children in Shimla, Himachal, North India. Indian J Ophthalmol. 2015;57(2):133–138.
18. Wedner SH, Ross DA, Balira R, Kaji L, Foster A. Prevalence of eye diseases in primary school children in a rural area of Tanzania. Br J Ophthalmol. 2000;84:1291–1297.
19. Onakpoya OH, Adeoye AO. Childhood eye diseases in southwestern Nigeria: A tertiary hospital study. Clinics (Sao Paulo). 2009;64(10):947–952. https://doi.org/10.1590/S1807-59322009001000003
20. Lu P, Chen X, Zhang W, Chen S. Prevalence of ocular disease in Tibetan primary school children a. Can J Ophthalmol. 2008;43(1):95–99. https://doi.org/10.3129/i07-194
21. Pi L-H, Chen L, Liu Q, et al. Prevalence of eye diseases and causes of visual impairment in school-aged children in Western China. J Epidemiol. 2012;22:37–44. https://doi.org/10.2188/jea.JE20110063
22. Osuchukwu NC, Osuchukwu EC, Akpabio I, Ekpenyong B. Socio-economic background and prevalence of visual defects amongst students in public and private secondary schools in Calabar Municipality. Glob J Pure Appl Sci. 2013;19:151–155.
23. Shrestha RK, Joshi MR, Ghising R, Rizyal A. Ocular morbidity among children attending government and private schools of Kathmandu valley. J Nepal Med Assoc. 2011;51(4):182–188.