

Amblyopia in Rural Nigerian School Children

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Abstract

Purpose: Globally, amblyopia remains a common cause of visual impairment in children. Early screening and treatment is necessary to prevent permanent visual loss. This study aimed to evaluate the prevalence, etiologic factors, and characteristics of amblyopia among rural, public primary school children in Ijebu East Local Government Area (IELGA) of Ogun state, southwest Nigeria. **Materials and Methods:** The study was a cross-sectional descriptive study conducted among pupils of randomly selected public primary schools in IELGA from 27th October to 7th November 2014. Data on sociodemographics, ocular history, and ocular examination were collected. Descriptive and comparative analyses were performed. Values of $P < 0.05$ were considered statistically significant. **Results:** There were 1180 public primary school pupils enrolled for the study. The data of 1153 pupils were analyzed giving a 97.7% response rate. The mean age was 9.2 ± 2.8 years with age range from 4 years to 16 years. There were more female students (586; 50.8%) with a male-to-female ratio of 1:1.03. Majority of the pupils were from the Yoruba ethnic group (819; 71.0%) and from basic one academic class (236; 20.5%). Six of the examined pupils were found to have amblyopia, giving a prevalence of 0.5%. The following three types of amblyopia were seen in this study: anisometric amblyopia (2; 0.17%), ametropic amblyopia (2; 0.17%), and strabismic amblyopia (2; 0.17%). Three pupils had unilateral amblyopia while three had bilateral amblyopia. All amblyopias were classified as mild-to-moderate amblyopia. **Conclusion:** The prevalence of amblyopia among these rural school children was low. However, because children with amblyopia could have a lifetime of blindness ahead of them, the number of “blind person years” in those whose blindness started in childhood is enormous. Early screening is required to prevent the attendant consequences of socioeconomic burden following visual impairment in this vulnerable subsection of the Nigerian rural populace.

Keywords: Amblyopia, children, nigeria, rural, visual impairment

INTRODUCTION

Visual impairment is a common cause of disability among children worldwide.^[1] Many of the causes are avoidable, being either preventable or treatable.^[1] There are 285 million people with visual impairment worldwide, of whom 39 million are blind.^[2] There are 19 million children who are visually impaired, with more than 60% from refractive errors that could easily be corrected.^[2] The global estimate of blind children below the age of 15 years is 1.4 million.^[2] Over 90% of these children live in developing countries where eye care services are not readily available.^[1]

Poor academic performance among school children has been associated with moderate-to-severe visual impairment not detected early.^[3] Hence, they are deprived of educational, physical, and mental development at the early and crucial phase of their life.^[3,4] Similarly, because of defective vision, risk of exposure to injury at home, in the school premises, and

because of road traffic accidents is higher among them. In addition, later in life, they are exposed to psychological stress, have problems with social integration, and have limitation of job prospect.^[5]

Childhood blindness is considered to be a high priority within the World Health Organization’s VISION 2020–The Right to Sight initiative, because many of the causes of childhood blindness are either avoidable or treatable.^[1] The second reason for high priority is because many of the conditions associated with childhood blindness are causes of increased childhood mortality. The third reason is because visual impairment affects the child’s education, which results in poor academic performance.^[3,4] Finally, the number of “blind

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years” because of all causes of blindness in children is almost equal to the number of “blind years” because of cataract in adults.

Amblyopia is defined as suboptimal vision in one eye despite best spectacle correction in the absence of any ocular or neural abnormality. Amblyopia occasionally occurs bilaterally because of bilateral visual deprivation, as seen in congenital cataracts not treated within the first few months of life and in high and uncorrected refractive error. It is a common pediatric eye condition with both functional and cosmetic consequences.^[6] It is a significant cause of unilateral visual reduction worldwide^[7] and is usually detected when decreased vision is noticed during vision testing in each eye. Amblyopia almost always affects one eye, and the amblyopic person usually has difficulty with fixation and binocular view, as well as seeing objects when crowded.^[8]

Lifelong visual impairment can result if early diagnosis and appropriate management are not commenced before the age of 8 years.^[6]

Globally, the prevalence of amblyopia among children and teenagers ranges from 0.20 to 6.2%.^[6,9-11] Variation in study designs and disease classification could be responsible for the disparities. This makes direct, intersurvey comparison difficult.^[12] Prevalence of amblyopia is often underestimated because of lack of awareness. Loss of vision due to amblyopia can be permanent, with early diagnosis and treatment providing a potential chance for significant visual recovery and visual preservation.^[13,14]

The first objective to ensure universal eye health is to formulate a global action plan 2014–2019, which encourages the member states to generate evidence on magnitude and causes of visual impairment.^[15] Against this backdrop, the Nigerian operational plan for the implementation of the VISION 2020: The Right to Sight document (2007–2011) proposed the establishment of school eye health screening in each local government area (LGA) to identify all cases of visual impairment among children.^[16] Although only few, privileged urban children whose parents/guardian can afford the hospital services have their eyes routinely examined, majority of the children never have a routine eye examination.

Most school-based surveys in Nigeria had focused on ocular status, visual impairment, and refractive errors among school children.^[17-21] However, there is paucity of disorder-specific data on amblyopia among rural Nigerian children. This study evaluated the prevalence, causes, and characteristics of amblyopia among a rural, primary school children in southwest Nigeria. In addition to adding to the fledgling literature data, the findings will provide evidence-based information that will drive policy formulation and implementation by the government to effectively reduce the burden of visual impairment and blindness among this vulnerable subsection of the Nigerian rural populace.

MATERIALS AND METHODS

Study area

The study was conducted in Ijebu East Local Government Area (IELGA), which is one of the 20 LGAs in Ogun state, southwest Nigeria. Ogun state is bounded in the north, northeast, east, and south by Oyo, Osun, Ondo, and Lagos states, respectively. IELGA was created in 1976 and has 11 political wards with a population of 110,196.^[22] Ogbere is the administrative headquarter of IELGA.

There are 64 public primary schools and 41 government-approved private primary schools along with 12 public secondary schools in IELGA. This community has 25 health centers that provide primary healthcare services, two general hospitals located at Ijebu-Ife and Ogbere as well as 24 private hospitals, and a specialist eye center in Imushin.

Study design

The study was a cross-sectional descriptive study conducted among pupils of simple, randomly selected, public primary schools in IELGA from 27th October to 7th November 2014.

Inclusion criteria included registered pupils from the selected public primary schools and pupils whose parent/guardian consented to their child’s participation in the study. Children in special school for the blind and handicapped children, parents/guardian or pupils who did not consent to participate, pupils with an only eye, and those with organic eye diseases were excluded from the study.

Sampling technique

The sample size of surveyed pupils was determined using the Fisher’s formula^[23] of prevalence determination, $n = z^2 p q / d^2$, where n is the desired sample size, z is the standard normal deviate (we used 1.96, which corresponded to the 95% confidence level), p is the proportion (prevalence) of the children population estimated to have visual problem (50%, 0.5), and d is the degree of accuracy set at 3% (i.e., 0.03). Thus, the minimal calculated sample size (n) was 1067. To make provision for attrition, 10% of the calculated minimal sample size (106.7) was added, and this resulted in a study sample size of 1174 pupils.

A multistage sampling technique was used to select pupils for this study. The first stage of the sampling was based on the information obtained from Ijebu East Local Government Education Authority. Sixty-four public primary schools were distributed in six different zones, with a total enrolment of 15,338 pupils. At least one school was simple, randomly selected through balloting for each zone as shown in Table 1. Totally, nine public schools were simple, randomly selected for this study.

The number of pupils enrolled per school was determined by probability proportional to size sampling based on the selected school registers, as shown in Table 2.

The third stage of sampling was class selection, which was also simple, randomly selected by balloting. At least six classes were selected per school, which represented basic one to six, depending on the number of classes available for each level.

The final stage involved pupil's enrolment into the study per class. This was achieved using the class register. The enrolment per class was proportional to gender distribution in the class and school population. Boys with even numbers and girls with odd numbers as arranged in the class register were pooled until the required sample for the class was obtained.

Ethics and consent

Human Subject Research Ethics Committee approval was obtained from the Institutional Review Boards of the Lagos State University Teaching Hospital, Ikeja, Lagos. Permission of Ijebu East Local Government Education Authority, Ogbere, Ogun state was also sought. The study was conducted according to the tenets of the 1968 Helsinki Declaration (last revised in 2008). Informed written assent was obtained from the pupils, and parental/guardian consent was obtained by *loco parentis* through the head teachers of the selected schools.

Study definitions

For the purpose of this study, amblyopia was defined as follows:

- (1) Difference in the best corrected visual acuity (BCVA) between the two eyes of two or more Snellen's lines in the absence of any significant organic lesion that could result in a decreased vision.

- (2) BCVA of $\leq 6/12$ bilaterally on the Snellen's chart in the absence of any significant organic lesion that could result in a decrease in vision.
- (3) BCVA of 6/36 or better in the amblyopic eyes is classified as mild-to-moderate amblyopia, and BCVA $\leq 6/60$ as severe amblyopia.

Standard definitions of different subtypes of amblyopia were adopted for disease classification. The criteria for the diagnosis were as follows:

- (1) Strabismic amblyopia: Defined as amblyopia in the presence of a heterotropia at distant or near fixation, in the absence of any anisometropia meeting the criteria for a combined mechanism amblyopia, or patients with strabismus along with refractive errors of 1 D spherical equivalent in one or both eyes or eyes with regular astigmatism 1.5 D in any meridian.
- (2) Anisometric amblyopia: Patients who are amblyopic in the presence of anisometropia, that is ≥ 1 D in spherical equivalent or ≥ 1.5 D difference in astigmatism between both eyes.
- (3) Combined amblyopia: Patients with either a heterotropia at a distance or near along with anisometropia of 1 D or more in spherical equivalent or ≥ 1.5 D difference in astigmatism in any meridian between both eyes.
- (4) Sensory deprivation amblyopia: Patients with a known cause of sensory deprivation such as media opacity or occlusion, with no primary heterotropia or refractive errors that could be related as the cause of the amblyopia.
- (5) Ametropic amblyopia: Patients with refractive errors >1 D spherical equivalent in both eyes resulting in subnormal vision in one or both eyes and no associated strabismus, anisometropia, or any other significant ocular disease.
- (6) Meridional amblyopia: Patients with regular astigmatism of ≥ 1.5 D in any meridian or those with irregular astigmatism in eyes, resulting in a decrease in vision in one or both eyes and no associated strabismus or anisometropia.

Table 1: Age and gender distribution of the pupils

Age range	Male, n	Female, n	Total, n (%)
5 years	–	6	6 (0.5)
5–9	321	298	619 (53.7)
10–14	232	274	506 (43.9)
15–19	14	8	22 (1.9)
Total	567	586	1153 (100.0)

Table 2: Unaided and best corrected visual status of the pupils

Variable	Unaided visual acuity		*Best corrected visual acuity	
	Right eye, n (%)	Left eye, n (%)	Right eye, n (%)	Left eye, n (%)
6/6	1063 (92.2)	1066 (92.4)	1141 (99.0)	1143 (99.1)
6/9	80 (6.9)	75 (6.5)	6 (0.5)	3 (0.3)
6/12	3 (0.3)	3 (0.3)	4 (0.3)	4 (0.3)
6/18	4 (0.3)	2 (0.2)	1 (0.1)	1 (0.1)
6/24		1 (0.1)		1 (0.1)
6/36	3 (0.3)	5 (0.4)		
6/60			1 (0.1)	
3/60		1 (0.1)		1 (0.1)
Total	1153 (100.0)	1153 (100.0)	1153 (100.0)	1153 (100.0)

*Best correction for vision was done using pinhole and refraction for those without spectacle.

Procedures

A pilot study was conducted in one of the public primary schools not selected for this study. The training of the team members was perfected, and the questionnaire was pretested and modified accordingly. Permission to carry out this study was obtained from Ijebu East Local Government Education Authority. The head teachers' office of each selected school was the first point of call. The purpose and benefit of this research work was explained to them. The parents of the pupils in selected schools were informed about the study through the Parent Teacher Association.

In each school, both teachers and pupils were educated on common ocular health problems.

Assent of all the participating children was obtained before the administration of the semistructured questionnaires, which was interviewer administered by the researcher and his assistants. The questionnaire was designed in English language, and interpretation and explanation was given when required.

Visual acuity (VA) was assessed unaided in an open corridor and sometimes under a tree, with a distant of 6 m from the patient, using Snellen's tumbling E charts. Pinhole VA was done for those with VA 6/6. Pupils with two or more optotype lines difference of BCVA between the eyes or $BCVA \leq 6/12$ in both eyes were further evaluated with single optotype VA (amblyopic) chart to demonstrate crowding phenomenon. All the candidates underwent color vision test using Ishihara color vision plates. Ocular alignment was evaluated using Hirschberg cornea light reflection and Krimsky test, and followed by cover/uncover test. The extraocular motility in all directions of gaze was assessed. Pupillary reactions, both direct and consensual, in a dimly illuminated room at far and near distances were checked, followed by penlight examination of the anterior segment including the lenses. Posterior segment examination was done with the aid of a direct ophthalmoscope in a dimly illuminated room. Noncycloplegic autorefraction was done on all pupils with unaided VA of 6/9 or worse. Pupils with unaided VA 6/9 underwent additional cycloplegic autorefraction using FA-6500 Xinyuan autorefractometer and then subjective refraction the next day. Full pupillary dilation for cyclorefraction was achieved with cyclopentolate 1% eye drops. Two drops were applied 5 min apart, and the patients were instructed to keep both eyes closed for 30 min. The refraction was done in the second week of the fieldwork after screening out pupils with unaided VA of 6/6.

During the study, antiallergy (Zinchlor; boric acid, sodium chloride, zinc sulphate, naphazoline hydrochloride, and chlorpheniramine maleate ophthalmic solution) eye drops were given to symptomatic children with allergic conjunctivitis. Similarly, children with various ocular diseases including optical, medical, or surgical cases were referred to Deseret Community Vision Institute with a referral note designed for this study.

Data obtained were entered into the computer and analyzed using the Statistical Package for Social Sciences version 21.0 software. Mean age and standard deviations of the study pupils were determined using the measure of central tendency. Frequency tables and charts were used to present the age groups, gender distribution, ethnic group, class distribution, and visual characteristics among others. Test of association was determined by chi-square test at a level of statistical significance set at P -value 0.05.

RESULTS

There were 1180 public primary school pupils enrolled for the study. Nineteen pupils did not complete their examination, seven pupils were not cooperative including one mentally challenged, and there was a child with only one seeing eye. Hence, data of 1153 pupils were analyzed accounting for 97.7% response rate.

The mean age was 9.2 ± 2.8 years with age range from 4 years to 16 years. The age and gender distribution is shown in Table 1. There were more female students (586; 50.8%) compared to male students (567; 49.2%), with a male-to-female ratio of 1:1.03. No significant gender difference was observed (P -value 0.413).

Majority of the pupils were of the Yoruba ethnic group (819; 71.0%) and from basic one academic class (236; 20.5%).

The presence of ocular symptoms was noted in 276 pupils (34.8%), whereas 206 pupils (17.9%) were aware of a family history of ocular disease. Although 23 (2.0%) pupils were currently using prescription spectacles, only 48 (4.2%) pupils had had previous eye examination by eye care personnel.

Most of the children (1064; 92.2%) presented with normal vision acuity. Visual profile of the pupils was as presented in Table 2.

Of the 1153 pupils, six had clinical evidence of amblyopia giving a prevalence of 0.5%. This was found mainly among pupils aged 10–14 years (5; 0.4%) followed by 5–9 years (1; 0.1%) of age ($p = 0.03\%$).

By study definitions, the following three types/causes of amblyopia were seen in this study: anisometric amblyopia (2; 0.17%), ametropic amblyopia (2; 0.17%), and strabismic amblyopia (2; 0.17%).

Three pupils had unilateral amblyopia while three had bilateral amblyopia. All were classified as mild-to-moderate amblyopia.

Majority of the amblyopic eyes had at least one line improvement in BCVA using single optotype charts (7; 77.8%). Two lines gain was noticed in 4 eyes (44.4%) and no improvement with single optotype charts in 2 eyes (22.2%).

Twenty-one pupils (1.8%, 95% CI: 1.2–2.4%) had abnormal color vision. Adjusting for age and gender, color vision defect

was found to be highest among male pupils (1.3%) and also those within 5–9 years of age with a prevalence of 1.0%.

DISCUSSION

The age range of pupils in this study was between 4 and 16 years with a mean age of 9.2 ± 2.8 years. This finding was similar to the age range reported by related studies such as Okoye *et al.*^[17] (6–16 years) and Ayanniyi *et al.*^[18] (4–15 years). The interstudy similarity in age range was because of the routine entrance age of children into primary school education.

The age group of 5–9 years constituted 53.7% of the study population, and it had the highest number of pupils compared to other age groups. Majority of the pupils in this age group belonged to basic one and two classes. This may be because of the recent increases in school enrolment or possibly increased dropout rate in upper classes. However, 1.9% of the pupils were 15 years old or more, which is relatively high. Ideally, this group of pupils should be in secondary school. Ignorance, poverty, or undue priority to farming activities are possible reasons for delayed enrollment for primary school education. This value is lower than what was reported by Okoye *et al.*,^[17] Ayanniyi *et al.*^[18] excluded pupils of age 16 years and above in his study.

The gender distribution of pupils enrolled for this study was approximately 1:1, though those of the female sex were slightly more. Similar findings were reported by Ayanniyi *et al.*,^[18] but slight male preponderance was reported by Okoye *et al.*^[17] The noticeable gender difference possibly may be because of difference in study areas. The study by Okoye *et al.* was done in southeast Nigeria, where there is preference for male education because of pro-male cultural bias.

The prevalence of amblyopia in this study falls within the global estimate of 0.2–6.2%.^[6,9-11] In Nigeria, Okoye *et al.*^[17] and Ayanniyi *et al.*^[18] reported prevalence of 0.3 and 0.4%, respectively. However, difference in sample size and methodology might contribute to the variable outcomes. Okoye *et al.* studied about twice the number of children in a cross-sectional survey compared to Ayanniyi *et al.*

The prevalence of amblyopia in this study is low; however, considering the lifetime socioeconomic burden of possible visual impairment, there is need for an eye healthcare policy advocacy that will support an improved and effective school eye health program particularly for those in rural Nigeria.^[17] This is collaborated by the Nigeria operational plan for the implementation of the VISION 2020: The Right to Sight document (2007–2011),^[16] which stipulates early detection and management of visual impairment among school children.

The majority of amblyopic pupils were within the age group of 10–14 years, which is statistically significant ($P=0.03$), with equal gender distribution. Similar findings were reported by Okoye *et al.* in Anambra^[17] (10–13 years) and Ayanniyi

et al. in Ilorin^[18] (8–15 years); however, the gender distribution was not stated in the Anambra study. It is important to note that all the affected pupils were above the age of 8 years, which is the critical period of amblyopia establishment. This strongly supports the need for early screening of school children for amblyopia.

However, appropriate measures were still taken by referring them to the base hospital for further evaluation and management. Amblyopia is a treatable condition in childhood, especially during the sensitive period. The limits of this period are still being defined.

The following three different types of amblyopia were noticed in this study: anisometric (2; 0.17%), ametropic (2; 0.17%) and strabismic (2; 0.17%) amblyopias. Fifty percent of the amblyopic pupils had bilateral amblyopia. All the amblyopic eyes had mild-to-moderate amblyopia, and there was no reported case of severe amblyopia among them. This was in contrast with what was reported by Ayanniyi *et al.*,^[18] three subtypes of amblyopia were with 80% cases of bilateral amblyopia, and 20% of the amblyopes had severe amblyopia. The variability in the pattern and types of amblyopia in the two studies may be because of the difference in the study area and population. Although this study was done in a core rural setting, Ayanniyi *et al.* studied children in an urban area with possible higher socioeconomic status. Wong *et al.*^[22] reported that individuals with greater education, near work-related occupations, and higher income were more likely to have longer axial lengths and vitreous chambers and more myopic refractions. Amblyopia is a syndrome of compromising deficits, which include increased sensitivity to contour interaction effects, abnormal spatial distortions and uncertainty, unsteady and inaccurate monocular fixation, poor eye tracking ability, reduced contrast sensitivity, inaccurate accommodative response, and reduced VA. This is often characterized with difficulty in reading when the letters or wordings are crowded together.^[8]

Crowding phenomenon was demonstrated by the amblyopic eyes in this study. At least one line gain in the BCVA single optotype chart was achieved in 77.8% of the pupils, whereas 44.4% of the pupils gained two lines. Studies done in Ilorin^[18] and Anambra^[17] did not elaborate on this phenomenon.

Twenty-one pupils had abnormal color vision in this study, which constituted a prevalence of 1.8%; this was significantly low with P -value of 0.001. There was no statistically significant age or gender difference despite high prevalence rate among the male sex (1.3%). All the amblyopes in this study recorded normal color vision. The prevalence obtained was comparable with (1.2%) that reported in Ilorin^[18] with almost equal gender distribution. A higher prevalence rate was reported in Jos^[21] (3.9%), and a rate of 0.1% was reported in Lagos.^[20] Congenital color vision defect is an X-linked inheritable disease, which can neither be cured nor is preventable. Early detection is

desirable among pre-primary and primary school children, which can be achieved by simple screening tests.

Among the five pupils with strabismus (0.4%), two of them have strabismic amblyopia, whereas the remaining three pupils have normal vision. This is similar to findings in Ilorin^[18] (0.4%), but the study had no record of strabismic amblyopia. These are potential amblyogenic factors if not detected and managed appropriately.

Limitation of study

Extrapolation of findings from this study is limited by its school-based nature, as many school children may not be in school for various reasons. A wider community-based study is, therefore, suggested.

CONCLUSION

Amblyopia is a significant cause of unilateral visual reduction worldwide. All the affected eyes had mild-to-moderate amblyopia with three subtypes of amblyopia recorded among six pupils. An education policy making vision screening mandatory for all school pupils at entry and after 2–3 years is suggested.

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Conflicts of interest

There are no conflicts of interest.

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