*ORIGINAL ARTICLE*

# Paediatric Refractive Errors in an Eye Clinic in Osogbo, Nigeria

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***ABSTRACT***

***BACKGROUND: Paediatric ophthalmology is an emerging subspecialty in Nigeria and as such there is paucity of data on refractive errors in the country. This study set out to determine the pattern of refractive errors in children attending an eye clinic in South West Nigeria.***
***METHODS: A descriptive study of 180 consecutive subjects seen over a 2-year period. Presenting complaints, presenting visual acuity (PVA), age and sex were recorded. Clinical examination of the anterior and posterior segments of the eyes, extraocular muscle assessment and refraction were done. The types of refractive errors and their grades were determined. Corrected VA was obtained. Data was analysed using descriptive statistics in proportions, chi square with p value <0.05.***
***RESULTS: The age range of subjects was between 3 and 16 years with mean age = 11.7 and SD = 0.51; with males making up 33.9%.The commonest presenting complaint was blurring of distant vision (40%), presenting visual acuity 6/9 (33.9%), normal vision constituted >75.0%, visual impairment20% and low vision 23.3%. Low grade spherical and cylindrical errors occurred most frequently (35.6% and 59.9% respectively). Regular astigmatism was significantly more common, P <0.001. The commonest diagnosis was simple myopic astigmatism (41.1%). Four cases of strabismus were seen.***
***CONCLUSION: Simple spherical and cylindrical errors were the commonest types of refractive errors seen. Visual impairment and low vision occurred and could be a cause of absenteeism from school.***
***Low-cost spectacle production or dispensing unit and health education are advocated for the prevention of visual impairment in a hospital set-up.***
***KEYWORDS: Child, Refractive error, Eye clinic, Low-cost spectacle dispensing unit***

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## INTRODUCTION

Refractive error is a condition where there is abnormality in the focusing of light by the eye on the retina(1).The attendant vision problems make it one of the commonest reasons for presentation in an eye clinic.

Refractive errors are a known cause of visual impairment worldwide with about 153 million people known to have impaired distance vision because of lack of correction (2). Severe refractive errors have been estimated to account for about 5 million blind people, while about 124 million people in the world have been estimated to have associated low vision (3).The World Health Organization defines blindness as 'visual acuity of less than 3/60 (0.05) with best possible correction or visual field less than or equal to 10 degrees from centre of fixation (ICD-10 Codes 3, 4, & 5). Low vision is defined as corresponding visual acuity of less than 6/18 (0.3) but equal to or better than 3/60 in the better eye with best correction (ICD-10 Codes 1 & 2)' (4, 5). More than half of the studies in a review of recent population-based surveys carried out on adults of $\geq$ 40 years old on blindness and visual impairment due to uncorrected refractive error (URE) in sub Saharan Africa showed that although not a cause of blindness, refractive error was a leading cause of visual impairment (6).

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This trend has also been seen among children. In Nigeria, studies have shown that refractive error is one of the common presentations in eye clinics. For example, URE constituted 14.3% of all paediatric cases presentation in a study carried out in Southwestern Nigeria (7), where it was second to allergic conjunctivitis. The proportion was 7.3% in the north in a study among primary school children (8), and in Southern Nigeria it was 28.95% of the total number of patients seen in a survey of paediatric diagnosis (9).

Various patterns and types of refractive errors have been documented across the world. For example, in China, it has been seen that there is a moderately high occurrence of astigmatism among ages of 3-6 years (10). In Sao Paulo, uncorrected refractive error was found to cause blindness and low vision which, however, were reversible in 4.8% and 1.6% respectively among the Brazilian population (11).

Vision disorders occurring in childhood may carry on into adulthood and become a problem later in life such as in educational attainment and job choices (12). Preventing amblyopia and strabismus are other reasons which are to be considered for the necessity of early correction of refractive errors. In a retrospective observational follow-up of hyperopic children of over 40 months, 24% of non-amblyopic and 33% of non-esotropic children became amblyopic and developed accommodative esotropia respectively (13).

Previous refractive error studies were not carried out solely among children. Paediatric ophthalmology is an emerging subspecialty in Nigeria and as such there is paucity of data on refractive errors. This study set out to determine the pattern of presentation of refractive errors in children attending a prototype clinic in Southwest Nigeria. This will now serve as a pilot study for community work to be done. It is hoped that knowing the common disturbing errors that make children complain and disturb them in their schooling or reading would guide in working towards the reduction of avoidable blindness from URE (14). These steps would go a long way in achieving the goals of Vision 2020.

This study was carried out to find out the presenting types, pattern and grades of refractive errors when presenting to the facility. To determine the pattern and types of refractive errors in children presenting at an eye clinic, we aimed at developing a treatment plan towards prevention of visual impairment.

## METHODS

The study was carried out in the eye clinic of Ladoke Akintola University of Technology Teaching Hospital (LTH) situated in Osogbo Osun State, Southwest of Nigeria. The state has an estimated population of over 3.7 million people, and is surrounded by neighbouring Oyo, Kwara, Ondo and Ekiti States(15). It therefore serves the people of these states by providing them with secondary and tertiary levels of eye care and services.

The study design was a descriptive study of Nigerian children presenting to an eye clinic with refractive error. The study population was aged 3 to 16 years presenting over a 2-year period to the eye clinic (July 2010 to June 2012). Children aged 3 years and above with refractive errors but without associated organic abnormality were included, while those below 3 years old, with associated organic pathology and aphakic refractive errors were excluded after history taking and clinical examination.

Demographic data such as age and sex were obtained. Presenting visual acuity measurement (PVA), one eye at a time, was done using the Snellen's literate or pictorial charts. For pre-school children, a matching test was used, and if uncooperative, was assessed as believed sighted if he or she picked up objects when tested from a distance of 3 meters. Visual acuity less than 6/9 either aided or unaided, and which improved with pin hole was classified according to the World Health Organization visual impairment category. The Essex Near Reading Test Type was used to assess near vision in children aged 5 years and above before and after refraction. Reading less than $N_6$ was presumed abnormal. Presenting complaints, past ocular history especially of spectacle wear were obtained. History of cataract surgery without intraocular lens implantation was excluded from the study. This was confirmed with clinical examination of the eyes. Family history of spectacle wear from childhood or youth and refractive errors were also obtained from the parent(s) or guardian(s). Bright pen light, Binocular Indirect Ophthalmoscope (BIO) and slit lamp were used to examine the anterior and

posterior segments of the eyes to exclude any organic pathology. Extra ocular muscle movements were also assessed to detect misalignment. Cyclopegia was achieved using a combination of Tropicamide (Mydriacyl 1% Alcon) and Cyclopentolate eye drops. Refraction was done using a Heine Beta 150 streak retinoscope from a distance of 66cm. Objective cycloplegic refraction and post mydriatic tests were carried out to find out the type and degree of refractive error. The axes of cylinders were also noted to be regular if they were within $90^0$ or $180^0$ and irregular if outside any of these two axes. The axes and power of the cylinders were verified and then refined using the Jackson Cross cylinder. Examination under anaesthesia was done for uncooperative children. The types of refractive errors were classified as spherical errors (SE) or cylindrical errors (CE). Errors were graded as shown in Table 1.

Table 1: Classification and Grades of refractive errors for children in a clinic in SW Nigeria

| | Errors of Refraction | |
|---|---|---|
| | Spherical (SE) | Cylindrical (CE) |
| Grades | SE (DS) | CE (DC) |
| Low | ± 0.50 to ± 1.25 | ± 0.25 to ± 0.75 |
| Moderate | ± 1.50 to ± 2.50 | ± 1.00 to ± 1.75 |
| Moderately high | ± 2.75 to ± 3.75 | |
| High | >± 4.00 | >± 2.00 |

*Above table was used in the methodology

The post-correction VA was also assessed and recorded. Spectacles were prescribed for correction upon improvement of VA. Those that did not improve by a minimum of one line but improved with the single Snellen's optotypes were considered to have amblyopia.

Malingering was defined in a participant that presented with asthenopic symptoms and had refraction done but had no error detected on refraction. The 'malingerers' and their parent(s)/ guardian(s) were counseled and given appointments for follow-up.

**Data Management:** Data was entered into and analysed using SPSS version 17 software. Descriptive analysis was carried out for frequencies, mean and standard deviation (SD). P-values were derived for statistical significance.

**Ethical Considerations:** Written informed consent was obtained from parents and assent from older children, while ethical clearance was obtained from LTH Ethical Committee.

## RESULTS

A total of 180 children, aged between 3 and 16 years, were seen during the two-year period at the outpatient eye clinic of the Teaching Hospital. Mean age was 11.9 years ± 3.2, while the modal age group was 11-16years (70.6%) ± 0.56.

Males constituted 33.9% while females were 66.1% in a male: female ratio of 0.34:0.66. The age group by sex distribution is as shown in Table 2.

The commonest presenting complaint was poor/blurring of distant vision (40%). Significantly, the higher age groups had the most presenting complaints, i. e. 45(25.0%) among 6-10 years and 127(70.6%) among 11-16 years; $\chi 2=19.41$, P=0.035. Complaints of lost or broken spectacles were up to 11(6.1%), $\chi 2=139.626$, $P<0.001$ (Table 2).

Table 2: Distribution of presenting complaints, spectacle usage and gender, by age group among children with refractive errors in a clinic in SW Nigeria

| **Presenting complaints** | **Age group(years)** *χ2=19.41, P=0.035* | | | **Ever used spectacles ?** *χ2=139.626, P<0.001* | | **Frequency %** |
|---|---|---|---|---|---|---|
| | 0-5 | 6-10 | 11-16 | Yes | No | |
| *Poor/blurred vision | 1 | 19 | 61 | 1 | 80 | 81(450 |
| Inability to see the board | 3 | 7 | 33 | 2 | 41 | 43(45) |
| *Eye aches/watering | 3 | 6 | 6 | 0 | 15 | 15(83) |
| Lost/broken glasses | 0 | 4 | 7 | 11 | 0 | 11(6.1) |
| Family history | 0 | 3 | 7 | 0 | 10 | 10 (5.5) |
| *Headaches | 1 | 2 | 6 | 0 | 9 | 9 (5.0) |
| Squint | 3 | 1 | 0 | 0 | 4 | 4(2.2) |
| None | 0 | 2 | 5 | 0 | 7 | 7(3.9) |
| **Total** | 8(4.4) | 45(25.0) | 127(70.6) | 14 (7.8) | 166 (92.2) | 180(100.0) |
| **Gender Distribution** | *χ2=3.214, P=0.200* | | | | | |
| Male | 4(50.0) | 19(42.2) | 38(29.9) | | | 61(33.9) |
| Female | 4(50.0) | 26(57.2) | 89(70.1) | | | 119(66.1) |
| **Total** | 8(44.0) | 45(25.0) | 127(70.6) | | | 180(100.0) |

*=Asthenopic symptoms 105(58.3%)

Only 14(7.8%) had ever worn spectacles while the rest of 16(92.2%) had never worn one. There was no child with abnormal near vision test.

Seventy five (75.6%) presented with normal vision, 44(24.4%) had low vision and 36(20.0%) had mild to moderate visual impairment and 4(0.4%) had severe visual impairment. The proportions of the common PVA were 6/9(33.9%), 6/4-6/6 (25.6%) and 6/12, 6/18 (9.4% each). The cross tabulation of PVA versus CVA is shown in Table 3.

Table 3: Presenting visual acuity (PVA) Versus Corrected visual acuity(CVA) among children with refractive errors in a clinic in SW Nigeria

| | **CVA** | | |
|---|---|---|---|
| **PVA** | **Normal vision 6/6-5/18** | **Moderate VI 6/24-6/60** | **Total %** |
| Normal vision (6/6-6/18) | 135(97.2%) | 1(0.7%) | 136(75.6) |
| Moderate VI(6/24-6/60) | **35(97.2%)** | **1(2.8%)** | **36(20.2)** |
| Severe VI(<6/60-3/60) | **3(37.5%)** | **5(62.5%)** | **8(4.4)** |
| **Total** | **173( 96.1 )** | **7( 3.9)** | **180(100.00)** |

$\chi2 = 77.265$, P<0.001

The common types of refractive error are shown in Table 4. The grades of spherical and cylindrical errors and their axes are shown in Table 5. Hypermetropia ranged from +0.50 DS to + 5.00DS, while myopia ranged from -0.25DS to -12.00 DS with 8.3% of them having a power of -4.00DS and above. There was also an increasing frequency in the power of myopia peaking at 16 years with power of -6.0DC, $\chi2=6.89$, P=0.639. There was an association which was not significant between the participants who had visual impairment (BCVA) and higher age group of 11-16 years following cross tabulation, $\chi2=3.214$, P=0.200. One was 14 years old, two

were 15 years old and three were 16 years old ($\chi 2$=6.89, P=0.639). Those with visual impairment in the BCVA group also had three myopes in the grade above -4.00DC, while two were in the -1.25 to -4.00DC grade in an association that was significant ($\chi 2$=15.532, P=0.005).

Table 4: Distribution of the common types of refractive errors among children with refractive errors in a clinic in SW Nigeria.

| Diagnosis | Frequency (%) | Total (%) |
|---|---|---|
| **Cylinderical Errors** | | **105 (58.3)** |
| Simple myopic astigmatism | 74(41.1) | |
| Compound myopic astigmatism | 16(8.9) | |
| Mixed astigmatism | 15(8.3) | |
| **Spherical errors** | | **50 (27.8)** |
| Myopia | 39(21.7) | |
| Hypermetropia | 11(6.1) | |
| **Anisometropia** | | **19 (10.6)** |
| **Malingering** | | **6 (3.3)** |
| **Total** | | **180(100)** |

Regular astigmatism was significantly more common than irregular astigmatism when cross tabulated with the grades of cylinder ($\chi 2$=609.427, P <0.001).The malingerers were all females. There were only 4 cases of strabismus seen during the study period.

Table 5: Distribution of the types, grades and axes of refractive errors among children in a clinic in SW Nigeria.

| **Types** | **Grades** | **Dioptric power** | **Frequency %** |
|---|---|---|---|
| **A. Myopia** | | | |
| | Low | - 0.25 to - 1.00 | 36(20.0) |
| | Moderate | - 1.25 to -3.75 | 16(8.9) |
| | High | - 4.00 and above | 15(8.3) |
| **B. Hypermetropia** | | | |
| | Low | + 0.25 to + 1.00 | 28(15.6) |
| | Moderate | + 1.25 to + 3.75 | 4(2.2) |
| **C. Astigmatism** | | | |
| | Low | - 0.25 to -0.75 | 97( 92.4 ) |
| | Moderate | - 1.00 to -2.75 | 7(6.7 ) |
| | High | - 3.00 and above | 1(0.9) |
| **Axes (n=105)** | | | |
| | Regular | | 90(85.7) |
| | Irregular | | 15(14.3) |
| | *$\chi 2$=609.427, P<0.001* | | |

## DISCUSSION

A higher female preponderance was observed in this study. This trend has been noticed by other authors in Southwestern Nigeria, who carried out studies on all age groups in contrast to ours that was conducted among children. For example, Ayanniyi et al, in their study, reported 60% females against 40% males in Ilorin (16), while Adeoti reported 39% females against 21% of males in the 10-20 years of age group (17). In a school prevalence study in Ludhiana city, Batra reported a prevalence of 14 % in girls and 9% in boys of ages 5-15 years (18).

The modal age group of 11-16 years could be seen as the group with the oldest children where it would be possible for them to express their complaints with better understanding.

Most, 105(58.3%), of the children had asthenopic symptoms. The presenting complaints were mostly poor or blurring of distant vision, aches and watering eyes. Inability to see the board clearly was the second commonest. Parents and guardians should be aware that such complaints, if not attended to, could lead to failures in school with the child eventually dropping out of school. This was corroborated by the Durban Declaration of 2007 on refractive error and service development which recognized that URE could seriously impact on the quality of life and productivity by limiting opportunities to education for children and employment in adulthood (2). There could also be further effects on the child's self-esteem, overall health and other social factors (2).

Over 90% of the children studied had never used spectacles. Their proportion was highest among those with complaints of poor or blurred vision, and this was not unexpected. Interesting to note is the fact that no child under 5 years had ever used glasses. This could be due to the fact that they had never been advised by an eye doctor to wear glasses. In the United States, 32.2% were reported to be wearing corrective lenses among the adolescents (19). This is a higher proportion when compared to ours. This could be due to a combination of factors like higher level of awareness, high income society and better health structure for the society.

The presenting visual acuity showed that 24.4% of them had low vision out of which 20% were moderately impaired and 4.4 were severely visually impaired. Comparatively, a study carried out in Malabo showed that the presenting visual acuities were high as there were low figures of refractive error with myopia of 5.2% and hypermetropia of 1.6% respectively (20).

The corrected VA showed that no participant had severe visual impairment, while only 5 had moderate visual impairment. These 5(2.7%) were detected to be amblyopic for the first time. This was a significant association with high spherical errors and occurrence in the oldest age group of 11-16 years (P=0.005). This indicates the need for an early correction of refractive error so that the brain can be stimulated during the developing and critical period, in order to prevent amblyopia.

The types of refractive errors documented in this study are similar to data obtained in other population i.e myopia, hypermetropia and astigmatism. In this study, among the cylindrical errors, simple myopic, followed by compound myopic astigmatism were the commonest, while among the spherical errors, myopia had the highest proportion followed by hypermetropia. There could be a genetic predisposition to astigmatism occurring commonly in this environment. However, genetic studies may be required to ascertain this. Environmental factors may also be contributory. Another study on refractive astigmatism in Nigeria showed that compound myopic astigmatism was the commonest type of astigmatism seen among all age groups (20), while others outside Africa showed that myopia is also the commonest occurring type of spherical errors among the African race. For example, a higher prevalence of myopia was seen in African American (6.6%) compared with Hispanic children (3.7%; $P<0.001$), while the reverse was the case with hyperopia (26.9% vs. 20.8% y, $P<0.001$) (23). However, among pre-school age, myopia tends to decrease with age probably due to emmetropization (21).

An association between increase of myopia with increased age was noticed in this study with its peak at age 16 years, $P = 0.639$. This trend of increasing myopia with age has been previously documented (22).

In contrast to our findings, studies carried out among pre-schoolers of 3-5 years showed that there was an equal risk of occurrence of astigmatism of greater than 1.00DC associated with hyperopia and myopia among the African Americans, Asians and Hispanics, while the American Indians had lower associated risk (23).Community studies would also be necessary to compare trends in astigmatism.

All the malingerers were found to be females. This may not be unassociated with peer group activities or fashion trends in wanting to wear spectacles. A similar study in Spain among children recorded 70% malingerers to be girls. Another 40% of them were seeking to wear glasses because they were diagnosed for non-organic visual function loss (24). Both children

and paren t(s)/guardian(s) were counseled and followed up. Some authors have suggested that the use of multifocal visual evoked response imaging system (VERIS) could assist in giving additional objective information on a patient where results of clinical assessment become inconclusive or conflicting (25). Recently, other authors have suggested that VER is expensive and time consuming, but rather, the use of certain simple specific tests such as "mirrors test, confusion with lenses test, Roth test, and Bravais test" could be used for making diagnosis (24).

It is assuring to know that the treatment of refractive errors is affordable and can be corrected easily, with appropriate optical prescription, while people with low vision may be assisted with low vision devices which as not recorded in this study. Furthermore, contact lens-wearing should be encouraged as it has been proven to be more cosmetically acceptable. It has been found to be preferable to wear than glasses, especially in a society where there are barriers to use of spectacles. It also has been shown to give a better quality of life (26).

The commonest presenting type of refractive error was myopic astigmatism and myopia. Visual impairment after correction was significantly associated with high myopia ($p = 0.005$). A well set up refractive- services in the hospital with low-cost glasses dispensing unit would help to reduce visual impairment from refractive errors. Advocacy should be made for an established school eye health programme in the state.

This study had limitations concerning the inability to carry out genetic studies. In order to determine possible linkages and causes why astigmatism commonly occurs in children in our environment, further genetic studies would be required.

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