





Prevalence of refractive error in paediatric age group in a tertiary eye center in Onitsha, south east, Nigeria

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ABSTRACT

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Paediatric ophthalmology is an emerging subspecialty in Nigeria and there is a paucity of data on refractive errors in the country. This study set out to determine the prevalence, type, and factors affecting refractive error among paediatric patients at Guinness Eye Centre, Nnamdi Azikiwe University Teaching Hospital (NAUTH), Onitsha. A retrospective cross-sectional study of 685 patients seen over a 3-year period using the simple random sampling technique. Collected data was analysed using the Statistical Package for the Social Sciences (SPSS) version 20. Of the 685 patients, 242 cases of refractive error were identified giving a prevalence rate of 35.3% with 66.5% of them being female and 33.5% males. The mean age range was 12.0 +/- 3.7 years. Prevalence increased with age from 1.7% among those 0-4 years to 46.3% among those 10-14 years. Myopia was the commonest type of refractive error (62%) while hyperopia was 22.7%. However, there was no case of astigmatism. Poor distant vision was the commonest presenting complaint (34.4%). There is a high risk for refractive error among children with eye complaints and females have a significantly higher proportion. It may be necessary to assess if the male children tend to shy away from complaining of any visual disturbance. Children with refractive errors may not be identified soon enough, and this could account for poor learning in childhood. So, children should be routinely screened for refractive error.

Contribution/Originality: Taking into account the available data for the prevalence of childhood refractive error, this study was conducted at the Guinness Eye Centre, Nnamdi Azikiwe University, Onitsha to assess the prevalence among children who presented with ocular complaints to corroborate other findings elsewhere.

1. INTRODUCTION

Refractive error has been listed among eye problems along with Cataracts, Trachoma, Onchocerciasis and Vitamin A deficiency whose prevention and cure should provide enormous savings and facilitate socioeconomic development [1]. Refractive error is the leading cause of visual impairment in children. Visually impaired children go through a lifetime of intellectual challenges coupled with possible emotional, social, and economic difficulties. [2]. Worldwide, the burden of visual impairment owing to refractive error is 153 million. 8 million among these cases have resulted in blindness. An estimate of 12.8 million children between the ages of 5-15 years are visually impaired due to uncorrected refractive error [3]. Uncorrected refractive error remains a public health problem.

The eye is divided into two compartments viz the Anterior and posterior compartments. The anterior compartment is made up of the cornea, iris, and anterior surface of the lens, and contains the Aqueous. The posterior compartment is made up of the sclera, uvea tract, and retina, and contains the vitreous. The cornea, lens, and vitreous are the eye's refractive media and help bring the image of an object to focus on the retina. Refraction is the bending of incident rays of light as it moves from one medium to another of different density bringing to focus on the retina. An eye that can focus parallel rays of light from infinity on the retina without accommodation is said to be Emmetropic. Refractive error occurs when the eye is not able to focus a parallel ray of light from a distant object onto the retina without using the accommodation or could only do so with accommodation [4]. The most common types of refractive error are Near-sightedness (myopia), Far-sightedness (Hyperopia), Astigmatism, and presbyopia [5]. In myopia, the image of a distant object is focused in front of the retina while in hyperopia, the image is brought to focus behind the retina. Astigmatism is a situation where the eye has different optic powers in different meridians.

1.1. Changes in Refraction During Childhood

Most normal children are born with some degree of hyperopia. The two eyes usually have the same refraction. Some children may be born with myopia, hyperopia, or Astigmatism, while others may have different focusing powers in the two eyes. If the two eyes have a difference of up to one dioptre refraction error especially if it is hyperopia, the more abnormal eye often develops what is referred to as amblyopia. If the refraction of both eyes is above three dioptres of hyperopia, the child often develops inward deviation of the eye called convergent squint (Esotropia). As the child grows, the eyes grow as well, so if myopia is present, it increases, and if hyperopia, it decreases. Astigmatism may increase or decrease. This is more pronounced during puberty. Some children may indeed be found at this period to have converted to myopia. Therefore, myopia may become more manifest among secondary school children, hence the name school myopia or developmental myopia among this age group. Towards adulthood and up to the twenties, the eye remodels continuously and the changes produced are towards the normalization of power. This tendency towards emmetropia occurs in this age group, and the process is called Emmetropization. After the age of 25, the power of the eye usually remains constant at the level attained at this age.

The power of the lens the individual acquires at age of 25 is usually the power it would retain until about forty years of age. At this age, the inability to read the fine print in dim light called presbyopia sets in. The cause is due to the hardening of the lens and decreased capacity for changing its shapes for accommodation. The age-related hardening of the lens is called nuclear sclerosis. The onset of nuclear sclerosis is usually dependent on other factors such as genetics, a person's previous refractive error, race, and occupation. In many people above sixty, they might find that they do not need lenses they previously used for reading, they read comfortably with the naked eye. This is called second sight. It is an extreme stage of nuclear sclerosis and may herald the onset of cataracts in a few months.

1.2. Causes of Refractive Errors

Light refraction depends on three key anatomical configurations which include the curvatures of the cornea and the lens, and the eye length [6].

- Eye Length: A shorter eyeball length focuses light behind the retina while a longer eyeball will focus light in front of the retina. In both cases, clarity of vision is impaired. When the eyeball is short, far objects are more easily brought to focus on the retina than nearer objects. The individual is referred to as being far-sighted (hyperopia). Conversely, when the eyeball is long, nearer objects are brought to focus on the retina than the ones far away. The individual is said to be near-sighted (myopia) [5].
- Lens curvature: The curvature of the lens is required to be adequate to be able to achieve good refraction. An overly curved lens results in myopia while a poorly curved lens results in hyperopia [5].

- Corneal curvature: The corneal curvature determines the degree of uniformity of refraction of an object by the eye. A poorly shaped cornea brings an image to focus irregularly due the varying degree of refraction at different points across it. This condition is referred to as astigmatism. It can occur alone or along with myopia or hyperopia [5].

1.3. Definition of Terms

- Visual impairment: International Classification of Diseases (ICD10) classified vision into normal and moderate vision, severe visual impairment, and blindness. This spectrum categorises moderate and severe visual impairment as low vision. When visual acuity cannot be improved beyond 20/40 or 20/60 with best correction, it is categorized termed visual impairment. In the USA, a visual acuity of 2/200 or worse after best correction ora visual field of 20° or less is regarded as blindness.
- Paediatric age: individuals who are less than 18 years old.
- Amblyopia: It is a condition where one eye is visually impaired due to a dissociation between the eye and its neural sensation. This condition occurs early during development after the brain has adjusted to a heavy reliance on images from the contralateral eye. The situation is also known as the lazy eye.
- Accommodation: it is the ability of the eye to adequately adapt its focus from closer objects to objects farther away. This is brough about by the adjustment of the shape of the lens due to ciliary muscle action on the zonular fibers.
- Anisometropia: In this condition, there is a significant disparity between the refractive powers of both eyes.

1.4. Statement of Problem

Non-correction of refractive error is a leading cause of childhood visual impairment all over the world. It remains an issue of public health concern and is of primary importance in the health strategy Vision 2020 – The right to sight [6]. Childhood visual loss adversely affects education, and impedes efficient learning. It negatively affects social and economic development and personal advancement [7]. In many cases, children do not complain of their visual difficulties by themselves. Therefore, most of the time, these go unnoticed and uncorrected leading to amblyopia. In some instances, it is also noticed by the school teachers and then reported to the parents. The ignorance about this disease in children affects not only the attitude of individuals, people, or communities but also their treatment choice and practice. These, which are mostly negative usually constitute unnecessary delays before seeking adequate medical treatment for the ailment as such allowing the development of amblyopia in uncorrected cases. Refractive error is of high prevalence in Africa according to studies, [8-12] however, few studies showed a low prevalence of refractive error in children [8, 13]. Many studies have consistently shown myopia to be the commonest type of childhood refractive error [8-12]. Poor vision has been shown to be associated with poor socioeconomic status [14]. Prevalence of refractive error according to sex varies from study to study [12, 15-19]. Refractive error prevalence has been observed to increase with age [20, 21] along with the myopia subtype [19, 22]. However, the prevalence of hyperopia decreases with increasing age [19, 22, 23].

It is a common situation among Africans and individuals in the tropical region of the world that refractive error is poorly diagnosed. Many cases of refractive error are underdiagnosed or unrecognized among children and these could go uncorrected leading to visual impairment. Adequate policy is required towards the need for early detection to prevent amblyopia. For this reason, this study was aimed at determining the prevalence and distribution of refractive error among children.

2. METHODOLOGY

Study Area: The study was carried out at Guinness Eye Center, Nnamdi Azikiwe University Teaching Hospital (NAUTH), Onitsha in Anambra state. It is a tertiary eye center in Southeast Nigeria and provides ophthalmology

and optometry services as well as related laboratory services. It offers out-patients and in-patients services with 32 in-patient bed spaces.

Study Design: The study was a retrospective cross-sectional study among paediatric patients (0-18years) who presented at Guinness Eye Centre, Nnamdi Azikiwe University Teaching Hospital, Onitsha, from first 1st January, 2015 to 31st December, 2017.

The sample was obtained by accessing case files of paediatric patients (0-18 years) who presented within this period. The files enrolled in the study were selected at random from among these. The obtained data was filled into the proforma and comprises Socio-Demographic information of patients, presenting complaints, presenting visual acuity, and type of refractive error. The Data was analysed using the Statistical Package for the Social Sciences (SPSS) version 20.

2.1. Sample Size Calculation

$$\text{Minimum sample size (n)} = z^2pq/d^2$$

Where:

n= sample size if the population is > 10,000

Z=Standard normal deviation at 95% confidence level =1.96

p= Expected proportion of refractive errors based on previous studies =22.5% [9] = 0.225

q=1-p=1-0.225=0.775

d= Precision or degree of accuracy =0.05

n= (1.96² x 0.225 x 0.775)/0.05² = 268.2

Table 1 shows the distribution of eye disorders of study patients and their prevalence.

Table 1. Prevalence of refractive error.

Diagnosis	Frequency	Percentage (%)
Refractive error	242	35.3
Infective conjunctivitis	196	28.6
Vernal conjunctivitis	94	13.7
Vernal keraconjunctivitis	70	10.3
Ocular allergy	30	4.5
Ocular trauma	29	4.2
Ophthalmia neonatorum	3	0.4
Dental symptoms	1	0.1
Others	20	2.9
Total	685	100

3. RESULTS

The table above shows the results of 685 respondents and that refractive errors accounted for 35.5% of the common ocular disorders and therefore the most prevalent.

Table 2 shows the age distribution of patients who presented with refractive error.

Table 2. Age of patients.

Age of patients years	Frequency N=242	Percentage (%)
0-4	4	1.7
5-9	56	23.1
10-14	112	46.3
15-18	70	28.9
Total	242	100

Note: Mean age = 12.0; Standard deviation = 3.7.

The table above shows that most of the patients who presented within the study period were between the ages of 10 and 14 (46.3%) followed by those who are between the ages of 15 and 19 (28.9%). The least are those from 4 years and below (1.7%). The mean age is 12.0 +/- 3.7 years.

Table 3 shows the sex distribution of patients with refractive error.

Table 3. Sex of patients.

Sex of patients	Frequency N=242	Percentage (%)
Male	81	33.5
Female	161	66.5

The table above shows that more females (66.5%) presented to the eye clinic due to refractive error within the study period compared to males (33.5%).

Table 4 presents the residence of the patients with refractive error.

Table 4. Residence of the patients.

Residence	Frequency N= 242	Percentage (%)
Anambra	230	95.1
Enugu	1	0.5
Delta	5	2.1
Ebonyi	1	0.5
Imo	1	0.5
Kogi	1	0.5
Abia	3	1.25

The table above shows that most of the respondents in the study population were from Anambra state (95.1%) The least are those from Enugu (0.5%).

Figure 1 shows the tribe of the patients with refractive error.

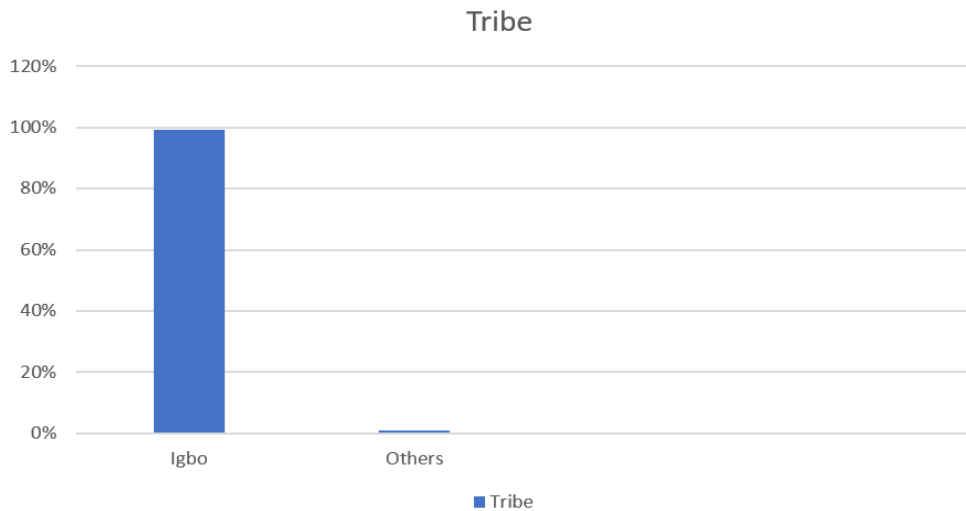


Figure 1. Tribe of the patients.

The graph above shows that many of the patients are from the Igbo tribe (99.2%) with the remaining (0.8%) from other tribes.

Table 5 shows the complaints of the patients with refractive error.

Table 5. Presents the complaints of the respondents.

Presenting complaints	Frequency N=242	Percentage (%)
Eye ache	32	13.2
Aversion to light	2	0.8
Blurring of vision	30	12.4
Brow ache	1	0.4
Burning sensation	1	0.4
Difficulty in seeing	21	8.7
Dragging irritation	4	1.7
Headache	4	1.7
Eye strain	1	0.4
Grittiness	1	0.4
Itching	13	5.4
Loss of vision from trauma	1	0.4
Redness	2	0.8
Night blindness	1	0.4
Nil complaints	5	2.1
Outward deviation of the eye	1	0.4
Poor distant vision	83	34.3
Poor vision	29	12
Tearing	10	4.1

The table above shows that most patient complaints were poor distant vision (34.3%). This is followed by eye ache (13.2%) and blurring of vision (12.4%). The least complaints were brow ache (0.4%), burning sensation (0.4%), eye strain (0.4%), trauma (0.4%), and outward deviation of the eye (0.4%).

Table 6 shows the types of refractive errors diagnosed in the patients.

Table 6. Types of refractive errors.

Diagnosis	Frequency	Percentage (%)
Hypermetropia	55	22.7
Hypermetropia with conjunctivitis	9	3.7
Myopia with vernal conjunctivitis	1	0.4
Pathologic myopia	1	0.4
Myopia with oculocutaneous Albinism	1	0.4
Hypermetropia with ocular allergy	5	2.1
Nil response	1	0.4
Myopia	150	62
Myopia with hypermetropia	2	0.8
Myopia with infective conjunctivitis	4	1.7
Myopia with Ametropia	4	1.7
Hypermetropia with cycloplegic reaction	5	2.1
Myopia with esotropia	2	0.8
Hypermetropia with eye strain.	2	0.8

This table shows that the major diagnosis made was myopia occurring alone (62%). This was followed by hypermetropia (22.7). Other diagnoses like pathologic myopia, myopia with vernal conjunctivitis, and myopia with oculocutaneous albinism were diagnosed, 0.4% respectively.

Table 7 shows the visual acuity in the right eye of study patients upon presentation.

The table below shows that the visual acuity on the right eye of most patients who presented was 6/6 (19.4%) and 6/9 (19.4%).

Table 8 shows the visual acuity of the left eye of the study patients upon presentation.

Table 7. Visual acuity of the right eye.

Visual acuity (R)	Frequency N=242	Percentage (%)
3/60	6	2.5
5/6	1	0.4
6/12	33	13.6
6/15	1	0.4
6/18	29	12
6/24	30	12.4
6/36	32	13.2
6/4	1	0.4
6/5	1	0.4
6/6	47	19.4
6/60	7	2.9
6/8	1	0.4
6/9	47	19.4
cf	2	0.8
Nil response	4	1.6

Table 8. Visual acuity of the left eye.

Visual acuity (L)	Frequency N=242	Percentage (%)
3/60	4	1.7
6/12	29	12
6/15	1	0.4
6/18	35	14.5
6/19	1	0.4
6/24	21	8.7
6/3	1	0.4
6/36	21	8.7
6/4	1	0.4
6/5	2	0.8
6/6	39	16.1
6/60	9	3.7
6/9	52	21.5
8/12	2	0.8
8/18	2	0.8
9/9	1	0.4
Cf	2	0.8
Nil response	4	1.6
NPL	2	0.8

The table above shows that most patients who presented had visual acuity in the left eye as 6/9 (16.1%). This is followed by 6/6 (16.1%) and 6/18 (14.5%). 0.8% of the patients had nil perception of light (NPL).

4. DISCUSSION

The prevalence rate of refractive error during the period under review was obtained to be 35.3% and refractive error was the most prevalent eye condition. This is consistent with multiple previous findings. However, the findings from a retrospective study by [Achigbu, et al. \[24\]](#) in South-eastern Nigeria and [Opubiri and Pedro-Egbe \[13\]](#) in Yenagoa Bayelsa State showed a much lower prevalence rate of 22.16% and 2.3% respectively [13, 24]. The much higher prevalence in this study may be related to the bias of hospital-based studies that may not reflect a wide representation of the study population. Comparatively, the 2.3% prevalence in the study in Yenagoa, Bayelsa State is much lower. The lower prevalence in that study may be due to variations in case definitions and methodology. Also, the lower prevalence may be related to the fact that the study by Opubiri was a screening program and so, some people with a low level of refractive error and who have normal visual acuity might have been screened out.

The most common type of refractive error in this study was myopia which accounted for 62% of cases. This is also similar to the findings of other studies including that of Semanyenzi, et al. [9], Ibeinmo, et al. [10] and Ahuama and Atowa [11]: Nebiyat, et al. [8]: Sushil, et al. [12], where it was observed that myopia was the most common refractive error. Hyperopia (Hypermetropia) was the second most common refractive error in the period under review accounting for 22.7%. It is similar to the findings of Ahuama and Atowa [11] where it was also observed that hyperopia was the second most common refractive error. However, it's not in keeping with the work in Semanyenzi, et al. [9]: Ibeinmo, et al. [10]: Nebiyat, et al. [8] and Sushil, et al. [12], whose works submitted that astigmatism is the second most common type of refractive error.

Age is one of the risk factors for refractive errors. Refractive error has been shown to increase with age. The mean age distribution in this study was 12.0 +/- 3.7 years. The Age distribution of patients with refractive error in the duration under review shows that refractive error was more prevalent between the ages of 10 and 14yrs (46.3%), followed by those between the ages of 15 and 18 years. The review shows that the prevalence of refractive error increased with age from 1.7% among children aged 0-4yrs to 46.3% among children aged 10-14yrs. This is similar to studies by Opubiri and Pedro-Egbe [13]: Biswas, et al. [20]: Norouzirad, et al. [19] and Yingyan, et al. [22], where it was also observed that the prevalence of refractive error increases with age. The increase in the prevalence of refractive error with age observed in these studies could be attributed to the fact that majority of the respondents had Myopia which increases in prevalence with age up to the age of 16 years before it decreases and becomes constant at the age of 25 years. In this study, there was a disparity in gender as 66.5% of the respondents were females while 33.5% were males. The higher prevalence in females may be in part because young females tend to report visual problems more than males.

In addition to being a hospital-based study, manual documentation and preservation of records also limits the strength of this study as there could be patient details lost due to storage. Also, the socioeconomic class of the respondents was not ascertained since it was a retrospective study and there was no direct contact with the respondents.

5. CONCLUSION

This study showed a high prevalence of refractive error among paediatric patients. Myopia was the most common refractive error demonstrated in the study while hyperopia was second. However, there was an increase in the prevalence of refractive error with age and a higher prevalence in the female gender. This may point to a need to assess the possibility of low presentation by the male children due to masked or concealed complaints among them.

6. RECOMMENDATIONS

Based on the findings of this study, the following recommendations are expedient:

1. Every child should be screened for refractive error.
2. Government should establish an eye center at each primary health care center.
3. Parents should be educated about refractive error and its danger if not corrected quickly.
4. School teachers should be trained on how to identify pupils with refractive errors.
5. There is a need for health education to increase awareness of refractive error.

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