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

Profile of refractive error in Ekiti, south western Nigeria

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Dates:
Received: 21 July 2017
Accepted: 04 Feb. 2018
Published: 21 June 2018

How to cite this article:
Ajayi IA, Omotoye OJ, Omotoso-Olagoke O. Profile of refractive error in Ekiti, south western Nigeria. Afr Vision Eye Health. 2018;77(1), a415. https://doi.org/10.4102/aveh.v77i1.415

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Background: Refractive error is one of the eye disorders with the capability of causing visual impairment. We needed to know the various types and proportion of refractive errors seen in patients attending an eye clinic at the tertiary health centre.

Aim: An observational study was carried out to determine the profile of refractive error in a southwestern Nigeria hospital.

Methods: All new cases with the diagnosis of refractive error between January 2015 and December 2016 had autorefraction and subjective refraction to determine the types and values of refractive error. Data were analysed with SPSS 20. Statistical significance was inferred at $p < 0.05$.

Results: Refractive error constituted 618 (21.4%) of the total new cases. The mean age was 39.3 ± 22.96 years. The male to female ratio was 1:1.8. Children constituted 25.7% of all the cases. The most common refractive error was myopia in 64.3%. A total of 312 (50.5%) patients had other co-existing ocular disorders with allergic conjunctivitis on the top of the list. The number of visually impaired reduced to 70 (5.64%) after the correction of existing refractive error with about 94.1% having their visual acuity restored to normal.

Conclusion: Refractive error was a common eye disorder among our patients with the proportion of children about a quarter of all patients. We recommend that childhood refractive errors should be given prioritised attention in eye outreach programmes.

Introduction

Refractive error is present when parallel rays of light passing through the refractive media of the eye do not come to a focus on the fovea leading to the blurring of the image seen by the affected eye. In myopia, rays come to a focus in front of the retina, whereas in hyperopia rays come to a focus behind the retina. However, in astigmatism, there is failure of formation of point image of a point object as a result of varying refractive powers in different meridians of the refractive media of the eyes.[1] Despite being one of the more easily corrected eye conditions, uncorrected refractive error still remains a significant cause of vision impairment and a global challenge.[2,3] In Nigeria, it accounts for 57.1% of moderate and 77.9% of severe visual impairment.[4] It is a complex and multifactorial condition with varying degrees of prevalence across populations with different ancestral origin.[5] In line with Vision 2020, it is one of the conditions to be treated in order to eliminate avoidable blindness. Though any age group can be affected, there is risk of a greater effect on children because they may not complain suffiently early.[6]

Optical and refractive services give immediate benefit in the reduction of the burden of mild and moderate visual impairment resulting from refractive error. Notwithstanding, most of the free eye outreach programmes in Nigeria only take into consideration the provision of readymade spectacles for presbyopia correction.

This study has been carried out to determine the various types and proportion of refractive errors seen among consecutive patients who presented to a state-owned tertiary eye-care centre. A hospital-based study like this has never been carried out among our outpatients. The results of this study will provide data for improved planning towards the delivery of optical and refractive services in our practice environs.

Methodology

The Ophthalmology Department of the Ekiti State University Teaching Hospital provides eye-care services to the people of the state and the neighbouring south western communities in Osun,

Ondo and Kogi states. There are four specialist ophthalmologists, three optometrists and eight ophthalmic nurses in the centre. The three optometrists had their training in the same institution and their results were compared intermittently to ensure standardisation. A serial record of details of all consecutive patients diagnosed as cases of refractive error over a period spanning between January 2015 and December 2016 was kept.

Details of demographic characteristics, presenting visual acuity, best corrected visual acuity (BCVA), type and value of refractive error as well as associated ocular comorbidity were extracted using a pretested proforma at the end of each clinic day which runs four days a week. Visual acuity classification was based on the World Health Organization category of vision.[7] All the patients were examined with pen torch, direct ophthalmoscope and slit lamp biomicroscope, binocular indirect ophthalmoscope and +78 D and gonioscopy as required to assess them for other co-existing anterior and posterior segment disorders by the specialist ophthalmologists.

All patients had objective refraction with autorefractor (Nidek ARK 730A) and subjective refraction to arrive at the final value of distance refractive error by the optometrists in the department. The subjective refraction was performed with patients positioned at 6 m away from the Snellen's chart. Each eye was corrected with the fellow eye occluded using the distance test type by first offering small plus and minus spherical additions until no further improvement can be made. The axis and power of the cylinder were also verified for those with cylindrical components. The near correction was performed by adding reading addition for those with presbyopia. Errors of refraction were entered as spherical equivalents. All patients who presented with only presbyopia without distance errors were regarded as emmetropic and excluded from the study.

The following terms were defined:

- Refractive error: Improvement in distance visual acuity with refraction
- Myopia: Refractive error of at least -0.5 D
- Hypermetropia: Refractive error of at least 0.5 D
- Astigmatism: Refractive error of ≥ -0.25 D
- High myopia: Error > -6 D
- High hyperopia: Error > 5.25 D
- Spherical equivalent: Sphere + (Cylinder/2)

Data was entered into SPSS (Statistical Package for Social Sciences 20.0) and analysed. Means and standard deviations were employed to measure central tendency, while frequencies were expressed in percentages. Relationship among categorical variables was compared using chi-square tests with statistical significance inferred at $p < 0.05$.

Ethical consideration

Ethical clearance was obtained from the Ethics and Research Committee of the Ekiti State University Teaching Hospital.

Results

A total of 618 patients presented with varying forms of distance errors of refraction. This constituted 21.4% of the total number of 2892 new patients seen within the time frame of this study. The ages ranged from 4 to 96 years with a mean of 39.33 years ± 22.96. Males accounted for 220 (35.6%), while females were 398 (64.4%), giving a male to female ratio of 1:1.8.

Children aged 16 years and below accounted for 159 (25.7%), while those above 16 years were 459 (74.3%). There was no significant gender difference in the risk of refractive error among those younger than 16 years of age (RR 1.083, CI 0.855–1.370, chi-square 0.288, $p = 0.564$). Figure 1 shows the age distribution of the study population.

As shown in Table 1, presenting visual acuity was within the normal range in 874 eyes (70.7%), while 359 eyes (29.06%) had visual impairment. The number of eyes with normal visual acuity increased to 1163 (94.1%) consequently to which eyes with visual impairment reduced to 70 (5.64%) with refraction. There were three blind eyes.

The errors of refraction are as shown in Table 2. Myopia-related errors constituted 795 (64.3%) of the total number of eyes. Hypermetropia-related errors were found in 347 (28.1%) cases. Astigmatism occurred in 574 (46.4%) of the total number of cases. The total number of cases with astigmatism with the rule was 244 (42.5%), while there were 330 cases (57.5%) of astigmatism against the rule. There was a statistically significant risk of astigmatism with the rule occurring in children under 16 years of age (RR 1.655, CI 1.270–2.151, $p = 0.001$). The values of refraction ranged from +0.25 D to +11 D for hyperopia and -0.25 D to -14 D for myopia, with a mean of 1.25 D and standard deviation of 1.74 D. Cylindrical error ranged from -0.25 D to -2.50 D.

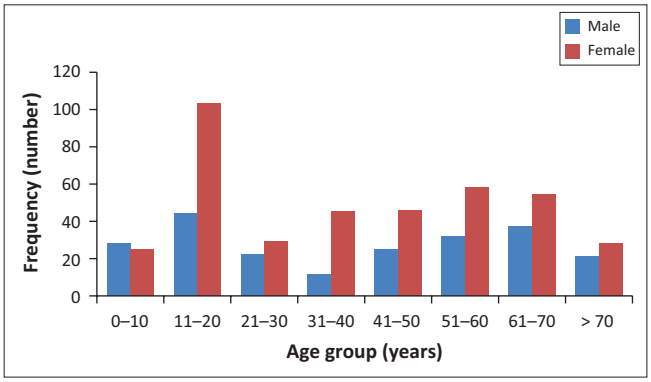

FIGURE 1: Age and sex distribution of patients.

TABLE 1: Visual acuity of eyes at presentation.

PVA	PVA eyes		BCVA	BCVA eyes	
	N	Percentage		*N*	Percentage
6/9–6/18	874	70.70	> 6/9	1163	94.10
6/18–6/60	310	25.10	6/18–6/60	51	4.10
6/60–3/60	49	3.96	6/60–3/60	19	1.50
< 3/60	3	2.40	< 3/60	3	0.24

PVA, presenting visual acuity; BCVA, best corrected visual acuity.

TABLE 2: Types of refractive errors.

Type of error	Right no	Left no	Total R + L no	
			N	%
Simple myopia	152	146	298	24.10
Simple myopic astigmatism	139	145	284	23.00
Compound myopic astigmatism	105	95	200	16.20
Simple hypermetropia	131	123	254	20.60
Simple hypermetropic astigmatism	1	-	1	0.08
Compound hypermetropic astigmatism	42	47	89	7.20
High hypermetropia	1	2	3	0.24
High myopia	6	7	13	1.10
Blind or artificial eyes	5	11	16	1.30
Emmetropia	35	43	78	6.30

TABLE 3: Co-existing ocular disorders with refractive error in the study population.

Type of co-existing eye disorder	Frequency	
	N	%
Allergic conjunctivitis	144	23.3
Lens opacity	54	8.7
Glaucoma	40	6.5
ARMD or other macular disorders	27	4.4
Pterygium or pingueculum	20	3.2
Retinal disorders	14	2.3
Others	14	2.3

ARMD, age-related macular degeneration.

Visual impairment spanned across all types of refractive error.

Other co-existing ocular disorders were present in 312 of 618 (50.5%) patients. As shown in Table 3, allergic conjunctivitis was the most common eye disorder associated with refractive error among our patients. This was seen in about a quarter of the study population.

Discussion

Refractive error is a common eye disorder in Nigeria and is one of the most significant causes of visual impairment and second foremost cause of blindness following cataract.[8] When left uncorrected, refractive errors can hamper school performance, reduce employability and productivity, and generally impair quality of life.[9]

In this study, we found refractive error accounting for 21.4% of the eye disorders seen in our eye centre. This agrees with previous reports from some other eye-care facilities in Nigeria in which refractive error was reported to be between 18.6% and 22.0%.[10,11,12] However, it is important to note that the rate reported from this hospital-based study is higher than the reports from some other community-based studies in Nigeria where rates between 2.6% and 15.4% have been reported.[13,14,15]

The mean age of the patients was 39.3 years ± 22.96 which coincides with the working-class age group in most countries. This finding is similar to the report from another tertiary eye-care hospital in Nigeria where a mean age of 39 years was reported with majority of the patients also within the working-class age group.[16] The proportion of refractive error versus age group peaked at the age group of 10–20 years for both males and females. This comprises the adolescents where an increasing tendency towards myopisation has been reported[17,18] with the potential to interfere with learning and academic productivity. Females were almost twice the proportion of males in this study. This occurrence was observed across all age groups. The higher number of females is compatible with some other studies within and outside Nigeria.[19,20,21,22] This preponderance of the female gender in this study may be explained by the higher prevalent nature of some types of refractive errors among females than males.[16]

Globally, refractive error accounts for 43% of the major causes of visual impairment and recent estimates reveal that there are 145 million people with low vision owing to refractive error. Another 8 million people are reportedly blind owing to refractive error.[9] The resultant morbidity from refractive error vary from place to place.[23] In Nigeria, uncorrected refractive errors are an important cause of visual impairment as well.[24] In this study, the majority of the patients presented with mild-to-moderate visual impairment (95.8%). This improved with refraction as evidenced by BCVA with percentage reduction in eyes with visual impairment from 95.8% to 5.4%. This marked reduction in the number of visually impaired eyes supports the fact that good optical services with affordable spectacles will provide an immediate reduction in the burden of visual impairment from refractive error.

Children aged 16 years and below constituted a quarter of the patients with refractive error in this study. Refractive error was reported as one of the most common eye disorders among children in a tertiary eye-care centre in Ile-Ife, Nigeria.[25] Globally, refractive error has been reported to be the main cause of visual impairment in children aged 5–15 years.[26] If left uncorrected, high refractive error in childhood may result in amblyopia and permanent visual impairment. Adigun et al.[27] in another study observed that childhood visual impairment can affect school learning, outdoor activity and the individual's social life or integration of the affected children. This is because children do not normally complain of visual problems. Early detection and timely treatment of eye disease is significant to avert vision problems and eye morbidities, which could affect their learning ability, personality and adjustment in school. Refractive services should be provided in a manner that is friendly to children. Most of the outreach services in our environment do not cater to childhood refractive errors as most distributed glasses are readymade reading spectacles.[28]

The leading eye disorder in this study was myopia. This constituted 64.3% of the total cases of refractive error. There are varied reports on the most common refractive error in Nigeria. While some have reported myopia as the most common distance refractive error,[16,29] others have reported astigmatism[30] and hyperopia.[31,32] Globally, it has been observed that uncorrected distance refractive error (mainly myopia) is the single biggest cause of vision impairment and this trend is increasing.[3] Some studies have attributed the increasing incidence of myopia to some environmental factors such as education and increased near work in addition to genetics.[16]

Also noteworthy in this study is the high incidence of astigmatism (46.4%). The presentation of this was in various forms as simple, compound myopic and hyperopic astigmatism. This agrees with reports of astigmatism as one of the most common refractive errors in clinical ophthalmic practice.[33] The most common type of astigmatism in our study was simple myopic astigmatism, followed by the compound myopic astigmatism. This differs from the studies of Emmanuel et al.[34] and Opubiri et al.[35] where compound myopic astigmatism was the most common type of astigmatism. Improvement in refraction technologies *vis-a-vis* and the availability of autorefractors in our centre has helped in making more precise and faster diagnosis of astigmatic errors.

The total number of cases with astigmatism with the rule was 42.5%, while 57.5% of the study population had astigmatism contrary to the rule. A significant risk of astigmatism with the rule occurring more in children under the age of 16 years was observed. This agrees with documented findings from previous studies.[36,37]

The leading co-existing ocular eye disorder was allergic conjunctivitis, followed by lens opacities. There are no documented evidences to show that refractive error increases the risk of these conditions; however, there is evidence to the fact that lens opacity can increase the risk of refractive error because of the alteration in the refractive index of the lens with onset of opacity.

One limitation of this study is that it was hospital-based with the possibility of an overestimation of the prevalence of refractive error as most people present to the hospital because of their vision challenges. Notwithstanding, the results can still be projected to the community as the hospital is a community-oriented health care provider.

In conclusion, refractive error is a common condition in our centre and it affects all age groups. Myopia is the most common type of refractive error in our centre and there is also a high proportion of patients with astigmatism. We therefore recommend a regular screening for school children so as to enable early detection of their refractive abnormalities. We also recommend that free outreach services be extended to the children by providing facilities for them to have their prescribed spectacles obtained if not fully sponsored, at a highly subsidised level.

Acknowledgements

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

All authors contributed significantly in design, data collection and data analysis, writing, editing and proof reading.

Funding information

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

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