Original Article

Refractive Errors in Patients Attending Eye Clinic of Barau Dikko Teaching Hospital (BDTH) Kaduna, North-West, Nigeria

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ABSTRACT

Refractive error is an important cause of visual impairment affecting all strata of life. In spite of available cost-effective means of correction, the uncorrected refractive error remains a major challenge because of the effects on productivity of the working-age and the education of the young. This study was set up to describe the pattern of refractive errors at Barau Dikko Teaching Hospital, Kaduna Northwest Nigeria. This is a retrospective study of all consecutive patients who visited the eye department, seen by Ophthalmologists and refracted by Optometrists. Records of all these consecutive patients were retrieved between January 2010 and April 2021, such as patient's Name, Age, Hospital number, Entry Visual Acuity (EVA), Refraction, Corrected Visual Acuity (CVA), Near Acuity (NA) as well as diagnosis made by the Ophthalmologist. These variables were transferred into a proforma and then analyzed using IBM Statistical Package for Social Sciences (SPSS) version 23. There were 4,640 eyes of 2,888 people, comprising of 1,114 males (38.6%) and 1,774 females (61.4%), with mean age of 43.8 (4-90) years. Myopia occurred in 1,574(33.9%) eyes, maximum was -13D, hypermetropia in 1,964(42.3%) maximum was +4D in naturally occurring and +16D in aphakic and astigmatism in 480(10.4%). Astigmatism consisted of 291(60.6%) myopia, 59(12.3%) hypermetropia and 130(27.1%) mixed. With the rule (WTR) was more in ages greater than 35 and against the rule (ATR) in the young. Most eyes at presentation had Moderate visual impairment VA ≥ 6/18 and the proportion that achieved normal vision ≥ 6/6 increased from 1,134(24.4%) to 3,818(82.3%) with refraction. The presbyopic correction was carried out on 1,423(49.27%) of the people. The most recurrent was 1.5D and ranged was 1.00D-3.25D. Refractive errors constituted a major burden of visual impairment in our facility and glasses provided satisfactory results in most of them.

Keywords: Astigmatism, Hypermetropia, Myopia, Presbyopia, Refractive errors, Visual impairment correction.

INTRODUCTION

Refractive error occurs when parallel rays of light from the environment are not focussed on the retina with accommodative capacity relaxed. It is termed myopia when focused in front and hypermetropia when behind or astigmatism when there are two separate foci. Refractive error is the leading cause of visual impairment [1] affecting 145 million people and second to cataract as a cause of blindness in 8 million people Worldwide [2]. The global pooled prevalence of types of refractive errors reported in 2018 systematic review was: Astigmatism 40.4%, hyperopia 30.9%, and myopia 26.5%. Europe and the Americas had a similar pattern but were different in Africa where astigmatism was 11.4%, hyperopia 38.6% and myopia 16.2% [3]. A national survey carried out in

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Nigeria reported 16.2% myopia less than 5.00D, 50.7% hypermetropia and 63.0% astigmatism.[4]

Several studies have shown refractive errors are common in young age group and in early middle age[5] with development being multifactorial as both genetic and environmental factors are involved[6] but presbyopia is caused by aging processes that lead to loss of accommodation. Significantly, it is possible to fully correct this major cause of visual impairment with glasses, contact lenses or refractive surgery after refraction but this may not be achieved when associated with other co-morbidities such as cataract, glaucoma, optic atrophy, corneal scar, retinopathy or complicated by amblyopia and sequelae of high myopia.

Refraction outcomes are important for correction of visual impairment and Spectacle is the most common, highly effective, and readily available and distribution of low cost in line with vision 2020 of WHO prevention of blindness programs is available. Despite this, only a few accesses refraction and correction. [4,7-9] This means that refractive error cannot be overlooked despite available cheap and effective means of a reversal of its visual impairing effect. The consequence of this is on quality of life, productivity, economic and educational performance [10,11] and is the reason it will continue to generate interest among eye care providers especially in Nigeria where 2/3rd of uncorrected persons exists.[4] Therefore, patients who routinely present to eye clinics in our environment for eye examinations and refraction with the intention to access correction is a commendable measure. We studied this category of patients to determine the pattern of refractive error at the Ophthalmology Clinic of the Barau Dikko Teaching Hospital (BDTH), Kaduna. It is hoped this research will add to existing knowledge and assist in planning interventional programs for the visually impaired arising from refractive errors in our environment.

MATERIALS AND METHODS

Study Setting

The Barau Dikko Teaching Hospital is the major State-owned public facility providing multi-disciplinary tertiary health services. The Ophthalmology department of the hospital is manned by Ophthalmologists, Optometrists, ophthalmic nurses, optical technician and other non-technical staff. All patients who visited the eye department were first attended to by the nurses who took their Visual acuity (VA). The unaided distance VA was determined using a Snellen lettered chart for the literates and the Snellen's tumbling 'E' chart for the illiterate patients at 6 meters, 3meters, and 2 meters, Counting Fingers (CF), Hand Movement (HM) and Perception of Light as the case may be. Each eye was tested separately and then with both eyes open and the vision recorded appropriately. The vision was further measured with a pinhole for those with VA < 6/9. The patients were referred to the ophthalmologists who sorted out those who had refractive errors and they were sent to the optometrists for refraction.

Procedure

This was a retrospective study. Records of consecutive patients who visited the optometric unit of the eye department between January 2010 and December 2021 were retrieved from the record books of all patients refracted. These record books contained the patient's Name, Age, hospital number, Entry Visual Acuity (EVA), Refraction, Corrected Visual Acuity (CVA), Near Acuity (NA) and Diagnosis made by the Ophthalmologist.

The procedure for determining VA by the optometrist was the same as carried out by the nurses. The Optometrists carried out objective refraction with retinoscopy (Heine brand) and or autorefractor and subjective refraction using trial lenses. The best-corrected visual acuity (BCVA), sphere, cylinder and presbyopic correction were recorded.

Eyes that distant and/or near vision improved with refraction were considered for this analysis.

Definitions

Myopia was defined as spherical power of
-5.75 DS to -0.25 DS
High myopia as spherical power of
-9.75 DS to -6.00 DS
Extreme myopia as spherical power of
≤-10.0 DS.
Hypermetropia was defined as spherical power of
+0.25 DS to + 5.75 DS

High hypermetropia as spherical power of +6.0 DS to +9.75 DS
Extreme hypermetropia as spherical power of ≥+10.0 DS.

Based on axis of principal meridian:

WTR if axis of the positive cylinder lied within 30 degrees on either side of vertical meridian,

ATR if axis of the positive cylinder lied within 30 degrees on either side of horizontal meridian,

Oblique if the axis lied btw 120 to 150 and 30 to 60 degrees.

Inclusion

All patients refracted within the study period, whose vision improved by at least one line and those with presbyopia.

Exclusion

Remained blind after refraction, presence of other ocular pathologies such as cataract, glaucoma, optic atrophy, and corneal opacities.

Data analysis

Statistical analyses were carried out using IBM SPSS statistics 21. Age, sex and presbyopia were analysed by individual patients while Visual acuity, myopia, hypermetropia and astigmatism each eye separately.

RESULTS

In the study period, 4,640 eyes of 2,888 people refracted were included; 256(11.0%) 2010-2011, 341(14.7%) 2012-2013, 358(15.4%) 2014-2015, 544(23.4%) 2016-2917, 591(25.5%) in 2018-2019, 230(9.9%) 2020-2021. There were 1,114 (38.6%) males and 1,774 (61.4%) females and the mean age was 43.8 +/-15.5 ranged 4-90 years. The age and sex distribution of patients refracted is shown in table 1.

Among the 4,640 eyes, 1,574 (33.9%) had myopia, range 0.25- 13D and eyes with ≤ 1.0D were 956(20.6%). Majority of eyes 936 (20.2%) had 0.5-1.00 D myopia. Hypermetropia was found in 1,964 (42.3%) eyes up to a maximum 16D, but maximum phakic hypermetropia was +4D while acquired (aphakic) ranged from 8 to 16D. Hypermetropia ≤ 1D was in 1,434(30.9%) eyes and those with ≥5D were all aphakic in origin, 36 (0.8%) eyes. Table 2 shows the severity by type of refractive error and figure 1, the distribution by age group.

Astigmatism alone or coexisting with other refractive errors was found in 480 (10.4%) eyes, ranged -5.0 to -0.25Dcyl and +0.25 to +3.00Dcyl. Astigmatism consisted of 291 (60.6%) myopic, 59 (12.3%) hypermetropic and 130(27.1%) mixed. Table 3, shows the severity and table 4, type of astigmatism in the 480 eyes.

Of the 480 eyes that had astigmatism, patients ages >35 years had 144(30%) eyes with WTR while 109(22.7%) had ATR and ages <35 years, the major type was ATR in 119(24.8%). Only 98 eyes had oblique astigmatism. Table 4 shows the types of astigmatism base on axis of steep meridian.

There were 1423 (49.3%) people that presented with presbyopia, age range 35-88 years with the peak age group 45-49 years constituting 340(11.8%) people. The Age group 40-55 years constituted 944 (32.7%) of those corrected. Half of the people 760 (26.3%) were corrected with less than 2D, with a peak correction of 1.5D. Presbyopic corrections alone was carried out on 744(25.8%), and with other refractive errors was 679(23.5%) that constituted 227(7.9%) myopes, 352(12.2%) hyperopes, 100(3.5%) astigmatism. Figure 2, shows the distribution of presbyopic correction in diopters (D).

Visual acuity

At presentation, there were 1,134 (24.5%) eyes with visual acuity 6/6-6/4, and those with ≤3/60 were 98(2.1%) eyes. In 2462(53.1%) eyes visual impairment was mild and 98(2.1%) had severe and profound Visual impairment.

After correction, 3,818(82.3%) had visual acuity 6/4-6/6 and 0 with ≤ 3/60 and those with ≤ 3/60 (severe and profound visual impairment) was 0(0%) as shown in tables 5 and 6 the presenting and best-corrected vision of eyes based on visual impairment categories.

Table 1: Age and sex distribution of patients refracted in the study period

Age group	Sex (%)		Total (%)
	Male (%)	Female (%)	
1-10	36(1.2)	32(1.1)	68(2.4)
11 -20	114 (4.0)	178(6.2)	292(10.1)
21 -30	88(3.1)	122(4.2)	210(7.3)
31 -40	156(5.4)	258(8.9)	414(14.3)
41 -50	324(11.2)	638(22.1)	962(33.3)
51 -60	252(8.7)	344(11.9)	596(20.6)
61 -70	114(4.0)	172(5.9)	286 (9.9)
71 -80	26(0.9)	22(0.8)	48(1.7)
81 -90	4(0.1)	8(0.3)	12(0.42)
Total	1,114(38.6)	1774(61.4)	2,888(100)

Table 2: The distribution of severity of type of refractive error.

Severity (D)	Myopia (%)	Hypermetropia (%)	Total (%)
Low (0.25-5.75)	1,472(31.7)	1,928(41.6)	3,400(73.3)
Moderate (6-10)	62(1.3)	8(0.2)	70(1.5)
Severe ≥10	40(0.9)	28(0.6)	68(1.5)
Total	1,574(33.9)	1,964(42.4)	3,538(76.3)

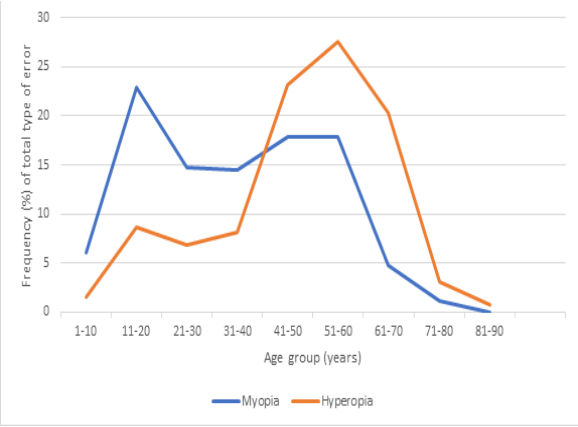

Figure 1: Pattern of distribution of myopia and hyperopia by age group.

Table 3: Distribution of Severity and type of astigmatism in eyes that were refracted.

Severity (DCyl)	Minus (myopic) (%)	Mix (%)	Plus (hypermetropic) (%)
<2.00DCyl	277 (57.7)	120 (25.0)	56 (11.7)
2-3.00DCyl	10 (2.1)	8 (1.7)	3 (0.6)
>3.00DCyl	4 (0.8)	2 (0.4)	0 (0)
Total	291 (60.6)	130 (27.1)	59 (12.3)

Table 4: Distribution of types of astigmatism base on axis of steep meridian and age groups in eyes that were refracted

Astigmatism	Age in years (%)		Total (%)
	<35	>35	
WTR	109(22.7)	144(30.0)	253(52.7)
ATR	119(24.8)	10(2.1)	129(26.9)
Oblique	77(16.0)	21(4.4)	98(20.4)
Total	305(63.5)	175(36.5)	480(100)

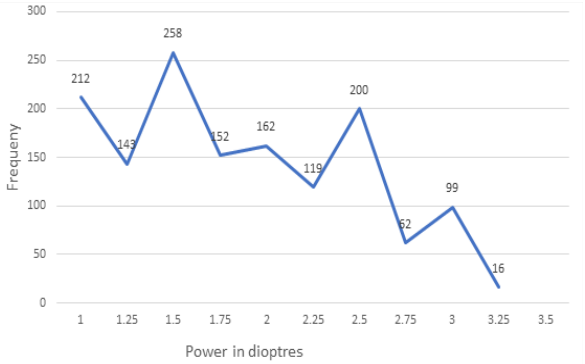

Figure 2: Presentation of the distribution of presbyopic corrections

Table 5: Presentation of best corrected visual acuities (eyes) of patients that were refracted.

Visual acuity	PVA (%)	BCVA (%)
6/4	0 (0.0)	2 (0.0)
6/5	770 (16.6)	2,412 (52.0)
6/6	364 (7.9)	1,404 (30.3)
6/9	1088 (23.4)	386 (8.3)
6/12	558 (12.0)	152 (3.3)
6/18	816 (17.6)	144 (3.1)
6/24	402 (8.7)	96 (2.1)
6/36	334 (7.2)	42 (0.9)
6/60	210 (4.5)	2 (0.0)
3/60	54 (1.2)	0 (0.0)
2/60	34 (0.7)	0 (0.0)
1/60	10 (0.2)	0 (0.0)
Total	4,640 (100.0)	4,640 (100.0)

Table 6: Presentation of the best corrected visual acuities (eyes) of patients that were refracted.

Class of vision	PVA Frequency (%)	BCVA frequency (%)
Normal	1,134 (24.4)	3,818 (82.3)
mild	2,462 (53.1)	682 (14.7)
moderate	946 (20.4)	140 (3.0)
severe	54 (1.2)	0 (0.0)
Profound	44 (0.9)	0 (0.0)
Total	4640 (100.0)	4640 (100.0)

DISCUSSION

Refractive errors are a common occurrence worldwide and uncorrected or under-corrected are a major cause of visual impairment[12] in spite of available highly effective cheap spectacles for

correction. It is commendable when patients willingly present to the hospital for refraction because this is the first step in reducing the burden of visual impairment arising from it. We have studied the pattern and present the findings of refractive error among patients that presented to the eye clinic of BDTH.

This study found the mean age of 43.76 years and peak in the age group 11-20 years and a late 41-50 years similar to other studies in Nigeria[13]. The reason being that school age is the time must people first discover their refractive error due to the inability to see the board or have asthenopia symptoms. The second peak is the period of onset of presbyopia when people have difficulty reading small prints or doing other closed work that consequently affects productivity prompting them to present for correction. The report of the global incidence of refractive errors and the developed world shows it is commoner in the younger age group 8-10 years [5] in contrast to the finding in this study. The reason may be due to late presentation to hospital by studied patients or due to inadequate implementation of school eye health programs in our environment where teachers are taught to screen, identify and refer cases in the early school age to eye care centres for correction. School eye health is an important component in eye care delivery in developing countries because it is the appropriate environment for activities towards the early recognition and prevention of disease and disability.

More eyes 3,408 (73.5%) in this study were found with mild-moderate VI consistent with findings of studies that showed RE was the major cause of moderate VI when all causative factors are considered.[4,30] However, with the increased eyes with normal vision (VA ≥6/6) from 1,134(24.4%) at presentation to 3,818 (82.3%) after refraction, suggest that corrective spectacles and contact lenses will reduce the burden of mild-moderate visual impairment arising from refractive errors in the study centre.

In this study, more women were found with refractive errors similar to other studies carried out in Kaduna and other parts of Nigeria, and Africa. [13, 16, 17] Kyari et al[18] in Nigeria's national survey suggests gender discrepancy exists even in types of refractive error; hypermetropia was significantly higher for women than men (55.6% versus 44.7%) consistent with findings reported in other parts of the world such as South India and the United States. [19,20] The association of female sex, eye disease prevalence, and service utilization in studies has been an issue since WHO made it theme of 2006 World Sight Day.[14,15] Despite this, the finding of this study suggest it will continue to be for sometimes to come.

In the present study, hypermetropia was most common, consistent with reports by Bagaiya[23] in Kaduna and Bekibele et al[24] in Ibadan, all in Nigeria. However, a systematic review of global data on refractive error by Hashemi et al[3] found that astigmatism was more prevalent worldwide including Europe, America, the Mediterranean, Western Pacific, SE Asia, Africa and so was Nigeria's national population survey[4]. Furthermore, studies that are not comparable to the global data and the finding in this study are myopia in Asia[21,22] and Ilorin Nigeria by Ayanni [13] and astigmatism in Bayelsa[25]. These dissimilarities may be attributed to a difference in sampling techniques and genetics.

The finding of more hypermetropia in this study may be a reflection that from birth many people are hypermetropic and there is a gradual correction with advancing age till about age 4 years. However, individuals that are excessively hypermetropic continue to manifest into adulthood and prevalence remains constant through middle age to increase in 45 years and above. Findings from this study show hypermetropia is stable at ages 20-40 years and thereafter increases. In the case of myopia, this study shows it peaks in the teenage years then stabilizes to drop at 70 years as hypermetropia rises. On this pattern, Bekibele[24] in his study found an association between hypermetropia and increasing age. His explanation was that the increasing refractive index of the cortex makes the whole lens more homogenous and with less converging power and an apparent increase of hypermetropia with age due to progressive failure of accommodation, as the tone of the ciliary muscle decreases, some of the latent hypermetropias become manifest.[24] Olurin[26] and Nnwosu[27] have also documented an increased prevalence of refractive errors in advanced age

groups in Nigeria.

The pattern of severity of errors differs, the study found only low errors up to a maximum of 4D in all eyes that presented with phakic hypermetropia in contrast high hypermetropic eyes were aphakic and acquired in origin. This suggests that natural high hypermetropia is rare in the study area. In myopic eyes, both low- medium, high and extremely high to maximum 13D naturally occurring were found. However, there were few reported cases of moderate-high phakic hypermetropia in one study, still high myopia was more prevalent in the studied population.[17]

The presence of high myopia in 102 (2.2%) eyes in our studied patients compared to that reported in 2% of Americans. Suggesting, 2.2% eye in our study area are at risk of pathologic changes and same proportion need continued fundal re-evaluation. High myopia is hereditary, starts in early childhood and has two effects; refractive and association with pathologic changes such as scleral thinning, staphylomas, retinal holes, detachments and maculopathies[28] that could lead to blindness.

In this study, we found that astigmatism occur alone or with other refractive errors in 480(10.4%) eyes. Some studies have reported higher proportion,[29] in Bayelsa state [25], astigmatism was the most common refractive error. The pattern we found in astigmatism of high powers was similar to spherical errors in terms of the type, with more high power myopic than hypermetropic errors (-5Dcyl and +3Dcyl). This may be attributed to patients being more tolerable to myopic than the hypermetropic high power cylinders. The present study gives the severity of astigmatism in the 480 eyes. Astigmatism is caused by cornea and lens but the subjective outcome is a sum of the two and is mainly due to difference in corneal curvature at different meridians. Classified based on the meridian with the most power, in childhood it is vertical shifting to horizontal in late age as is found in this study.

The difficulty with near vision referred to presbyopia is not a refractive error but a physiological change that is assessed alongside refractive errors with the age of onset generally considered 40 years but this study found that the earliest age was 35 years, peak 45-49 years in 340 (11.8%) people with minimum lens power 1D and ranged from 1 - 3.5D. A younger age 30 years, was reported in Bayelsa with a range of 1-5D [25] while an older in Ibadan with a range of 1.25-3D.[24,25] The Ibadan study has a relatively older study population which may account for the high value of least ADD while the Bayelsa[25] study may have included low vision patients being reasons for the difference in maximum ADD. Half cases in our study were corrected with less than 2D lenses and peak correction of 1.5D, in Bayelsa[25], the majority were between +1.50D to +2.50D accounting for 82.9% of the total correction. Overall, the proportion of eye with presbyopia in the present study 1423(49.27%), varied with other studies in Nigeria, 74.9% in Bayelsa[25] and 97.7% in Ibadan[24]and coexisted more with hyperopia 352(12.2%) than myopia 227(7.9%) in our study. The different study populations may account for the varied age of presentations and the higher coexistent with hyperopia may be that both are near vision problems and are more likely to present to hospital early unlike myopics who cope better at near distance.

CONCLUSION

This study found that refractive error is predominantly hypermetropic but at high errors, the pattern changes to myopia while, astigmatism was more of myopia and was predominantly against the rule in the young and the visual impairments of these errors can significantly be corrected by refraction.

Recommendation

Based on this study, refraction corrects the major cause of visual impairments in our environment and should be incorporated into the basic eye care services at the primary health centers. These level of health care workers need to undergo training on basic refraction to achieve quality service delivery .

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