ORIGINAL ARTICLE

Refractive errors in patients attending a private hospital in Jos, Nigeria

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Abstract

Objective: This study was carried out to determine the prevalence and pattern of refractive error in patients presenting to a private hospital.

Materials and Methods: Records of all patients who presented at the hospital from 2000 to 2009 with visual acuity (VA) of 6/9 or less and showed improvement in distance vision of one or more lines with refraction were reviewed. The eye with the better presenting visual acuity was used for classifying the patient. The spherical equivalent refraction was used with the formula (sphere plus cylinder/2).

Results: Two thousand eight hundred ninety eight patients were seen at the hospital for various eye problems. Six hundred one (20.7%) patients with distant VA which improved with refraction were considered for this analysis. Two hundred twenty one (36.8%) of patients with refractive error were visually impaired (VA <6/12-3/60). Blindness (<3/60 - none perception of light) was seen in 91 (15.1%) of the patients, seven of whom were aphakic. Best corrected visual acuity increased the number of patients with normal visual acuity from 289 (48.1%) to 579 (96.3%). Overall visual impairment (VI) (<6/12-3/60) was reduced from 221 (36.8%) to 22 (3.6%). Severe visual impairment and blindness were completely eliminated just with refractive correction. Of those with refractive error, there were 35.8% with myopia, 29.5% with hypermetropia and 34.8% with astigmatism. Males had slightly more myopia and astigmatism, and female more hypermetropia though the difference was not statistically significant. Refractive error was seen more among the students 207 (34.4%) and civil servants 189 (31.4%) and least among the artisans 7 (1.2%). Anisometropia of ≤ 1 D, >1-2 D, >2-3 and > 3 D were found in 76.5%, 11.8%, 5% and 5.0% respectively.

Conclusion: The study shows that refractive error is a common cause of VI and myopia is the most common type. It confirms that most of the refractive error can be corrected with off-the-shelf spectacles.

Key words: Anisometropia, astigmatism, hypermetropia, myopia, refractive error

Date of Acceptance: 2-May-2013

Introduction

Recent surveys have estimated that 285 million people worldwide are visually impaired from all causes, and 153 million of these, (including eight million blind) from uncorrected refractive errors.[1] The distribution of refractive error varies with education, urbanization and race, and has a familial tendency. Other risk factors are involvement in sports and outdoor activities.[2] Visual impairment (VI) from uncorrected refractive errors affects children and adults and sometimes leads to loss of education and employment opportunities, loss of economic gain for individuals and their families, societies, and also leads to impaired quality of life.[3]

Most of the studies performed on refractive in Africa are mainly among school children and show refractive error (RE) to be a significant cause of VI. In Ghana,[4] RE was responsible for VI in 85.9% of the children tested. In Tanzania[5], RE was found in 6.1% of children and accounted

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Access this article online

Quick Response Code:

Website: www.njcponline.com

DOI: 10.4103/1119-3077.122863

PMID: *******

for 88.5% of VI. In a South African survey in children the prevalence of uncorrected visual acuity (VA) of ≤6/12 was 1.4% and RE was the cause of reduced vision in 63.6% and amblyopia in 7.3%.

Studies in Nigeria have shown RE to be the leading ocular condition and cause of VI.[6-11] The Nigeria National Blindness and VI Study found uncorrected RE responsible for 77.9% mild VI, 57.1% of moderate VI, 11.3% of severe VI and 1.4% of blindness.[12]

Refractive error is one of the simplest and most effective treatable causes of VI and blindness, a point noted by various studies.[3-13] Though RE is easily treatable, refractive services are not easily available or affordable by many people in developing nations.

This paper reports the prevalence and pattern of RE seen at a private hospital in Nigeria and contributes information necessary for the planning of eye care services in this region.

Materials and Methods

This is a descriptive retrospective hospital based study of patients with impaired VA that improved with refraction. Records of all consecutive patients who presented at the hospital from the year 2000 to 2009 with VA of 6/9 or less and showed improvement of one or more lines in distance vision with refraction were reviewed. The eye with the better presenting visual acuity (PVA) was used for classifying the patients. The formula sphere plus cylinder/2 was used to determine SER.

The patients' demographic information such as age, sex, ethnic group, occupation, and address were retrieved from the records. The patients' complaints, family history of use of spectacles, examination findings, including VA and diagnosis were also retrieved.

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 m, 4 m, and 1 m (counting finger) 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 pin hole and or with glasses if normally worn. This stage was usually carried out by nurses. The consultant ophthalmologist and optometrist carried out the objective refraction with retinoscopy (Heine brand) and subjective refraction using trial lenses. The best corrected visual acuity (BCVA) was recorded.

Normal visual acuity for the purpose of this study was defined as a PVA equal to or better than 6/12 in the better eye;
Mild visual impairment (Mi. VI) was defined as a VA of less than 6/12, but equal to or better than 6/18 in the better eye,
Moderate visual impairment was defined as a PVA of less than 6/18, but equal to or better than 6/60) in the better eye,
Severe visual impairment as a PVA of less than 6/60, but equal to or better than 3/60 in the better eye, and
Blindness was defined as a PVA of less than 3/60 in the better eye.
Low myopia was defined as < -0.50 D to > -5.0 D,
High myopia as ≤ -5.0 D to > -10.0 D and
Extreme myopia as (≤ -10.0 D).
Low Hypermetropia was defined as > +0.5 D but < +5.0 D,
High hypermetropia as (≥ +5.0 D but < +10.0 D) and
Extreme hypermetropia as (≥ +10.0 D.
Permission to use the records of patients for the study was obtained from the management of the Hospital. The study also complied with Helsinki declaration and subsequent revisions concerning human subjects.

Statistical analyzes were carried out using the SPSS version 17.0 software (SPSS Inc., Chicago, IL, USA). Chi-square test was used to calculate the difference between percentages and *t*-test was used to calculate the difference between means. $P < 0.05$ was considered to be statistically significant.

Results

There were 2898 patients seen at the hospital for various eye problems between 2000 and 2009. Six hundred one (20.7%) patients with distant vision which improved with refraction were considered for this analysis. Their ages ranged from 5 years to 85 years (SD ± 17.5). Figure 1 show the age distribution. Two hundred twenty one (36.8%) patients with RE were visually impaired (VA < 6/12-3/60). Blindness (<3/60-NPL) was seen in 91 (15.1%) of the patients, seven of whom were aphakic. Figure 2 shows the presenting and BCVA of patients with RE. Table 4 shows the gender distribution of patients with anisometropia.

Myopia alone was seen in 215 (35.8%) of the patients, hypermetropia with aphakia was present in 177 (29.5%), and aphakia alone in 7 (1.2%)). Astigmatism (inclusive of myopic and hypermetropic astigmatism) was found in 209 (34.8%). Astigmatism with-the-rule (WTR) was present in 105 (17.5%), astigmatism against-the-rule (ATR) was seen in 86 (14.3%) and oblique astigmatism in 18 (3%) of patients. Figure 3 shows the types of RE in the patients seen at the hospital.

Overall more males were seen with myopia and astigmatism than with hypermetropia, while females had the three conditions evenly distributed. This difference was not statistically significant ($P = 0.349$). Table 1 shows the sex distribution of patients with RE.

In all, more people in ages 11-20 and 41-50 years presented with RE. Myopia increased from 42 (19.5%) in the age

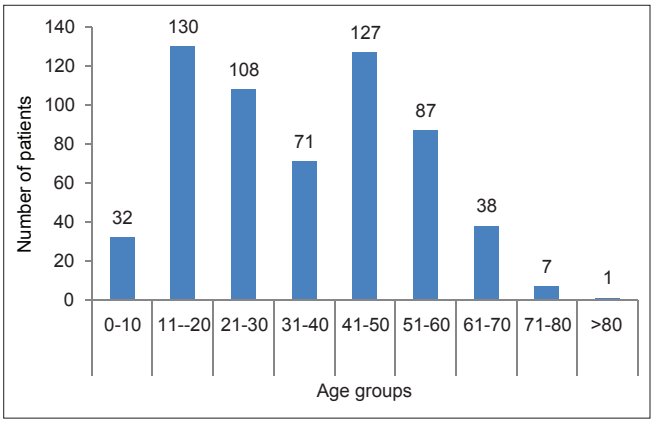

Figure 1: Age distribution of patients with refractive errors

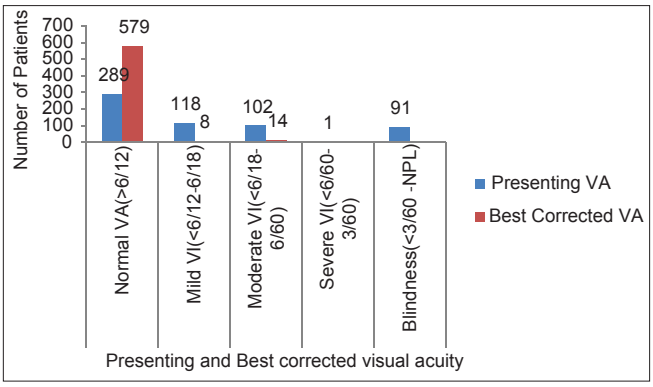

Figure 2: Presenting and best corrected visual acuity (WHO and International Standard)

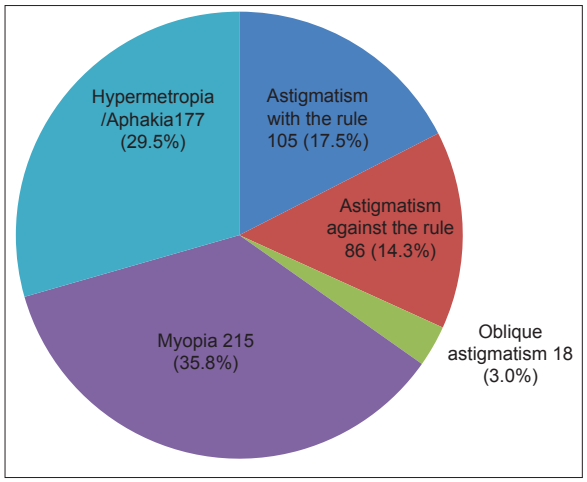

Figure 3: Distribution of types of refractive error

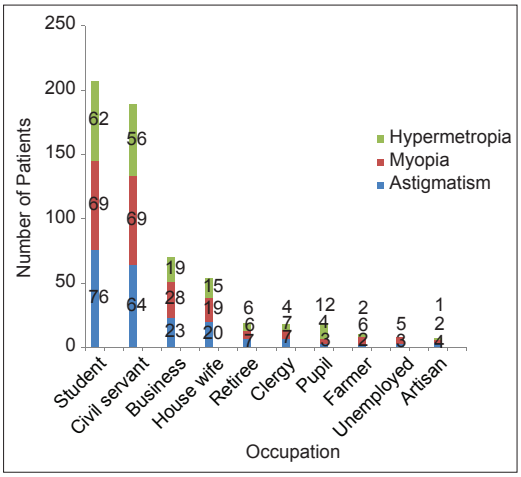

Figure 4: Distribution of refractive errors in different occupational groups

Table 1: Sex distribution of patients with refractive error

(*n*/%)	Type of refractive error (*n*/%)			Total (*n*/%)
	Astigmatism	Myopia	Hypermetropia	
Female	109 (33.2)	114 (34.8)	105 (32.0)	328 (100.0)
Male	100 (36.6)	101 (37.0)	72 (26.4)	273 (100.0)
Total	209 (34.8)	215 (35.8)	177 (29.5)	601 (100.0)

P=0.349

Table 2: Age distribution of refraction types

Age groups in years	Refractive error *n* (%)			Total *n* (%)
	Astigmatism	Myopia	Hypermetropia	
0-10	8 (25.0)	10 (31.3)	14 (43.8)	32 (100.0)
11-20	53 (40.8)	42 (32.3)	35 (26.9)	130 (100.0)
21-30	33 (30.6)	41 (38.0)	34 (31.5)	108 (100.0)
31-40	29 (40.8)	24 (33.8)	18 (25.4)	71 (100.0)
41-50	37 (29.1)	52 (40.9)	38 (29.9)	127 (100.0)
51-60	31 (35.6)	30 (34.5)	26 (29.9)	87 (100.0)
61-70	15 (39.5)	12 (31.6)	11 (28.9)	38 (100.0)
71-80	3 (42.9)	4 (57.1)	0 (.0)	7 (100.0)
>80	0 (0.0)	0 (0.0)	1 (100.0)	1 (100.0)
Total	209 (34.8)	215 (35.8)	177 (29.5)	601 (100.0)

P=0.913

group 11-20-52 (24.2%) in ages 41-50 years. Hypermetropia was more prevalent in the age group 41-50 years, accounting for 38 (21.5%), whereas astigmatism was seen more in the age group 11-20 years accounting for 53 (25.4%). This did not reach statistical significance ($P = 0.913$). Few patients presented with RE after the age of 70 years. Age distribution of RE is shown in Table 2.

Refractive error was seen more among the students 207 (34.4%) and civil servants in 189 (31.4%) and least among the artisans 7 (1.2%) This difference was not statistically significant (P = 0.425) [Figure 4]. The spherical equivalent was taken of the lenses of the eye with the BCVA. One hundred seventy four 174 (29.0%) patients had < -0.25 D to - 0.50 D and + 0.25 D to + 0.50 D. Low myopia was seen in 254 (42.3%), high myopia was found in 21 (3.5%) and extreme myopia in 4 (0.7%). Hypermetropia of ≥+0.5 D but <+5.0 D was seen in 139 (23.1%), high hypermetropia was found in 2 (0.3%) and extreme hypermetropia was seen in 7 (1.2%). The SER is shown in Figure 5.

Table 3: Sex distribution of spherical equivalent refraction

Sex	Spherical equivalent refraction (*n*/%)							Total (*n*/%)
	NVA	LM	HM	EM	LH	HH	EH	
Female	85 (25.9)	137 (41.8)	12 (3.7)	2 (0.6)	88 (26.8)	(0.0)	4 (1.2)	328 (100.0)
Male	89 (32.6)	117 (42.9)	9 (3.3)	2 (0.7)	51 (18.7)	2 (0.7)	3 (1.1)	273 (100.0)
Total	174 (29.0)	254 (42.3)	21 (3.5) (100.0)	4 (0.7)	139 (23.0)	2 (0.3)	7 (1.2)	601 (100.0) (100.0)

NVA=Near normal visual acuity: <−0.25 to −0.50, +0.25 to+0.50 D; LM=Low myopia: <−0.50 to >−5.0 D; HM=High myopia: ≤−5.0 to >−10.0 D; EM=Extreme myopia: ≤10.0 D; LH=Low hypermetropia: >0.5 to<+5.0 D; HH=High hypermetropia: ≥+5.0 to<10.0 D; EH=Extreme hypermetropia: ≥+10.0 D

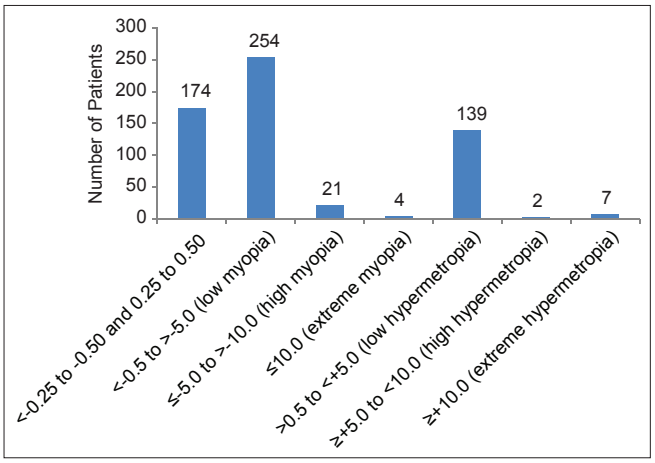

Figure 5: Spherical equivalent refraction in patients

Anisometropia was present in 221 (36.8%) of patients with RE. The anisometropia of ≤ 1 D was present in 169 (76.5%), that of >1-2 D was found in 26 (11.8%), of > 2-3 D in 11 (5.0%) and > 3 D in 15 (6.7%) of the patients. Low and high anisometropia were more prevalent among the females 88 (80.7%) and 9 (8.3%) respectively as opposed to males. More males 25 (22.3%) had medium anisometropia (>1-3 D). In all more males 112 (50.6%) than females 109 (49.3%) were found to have anisometropia. This difference was not statistically significant. Of the 32 and 130 subjects respectively in age groups 0-10 and 11-20, 11 (34.4%) and 49 (37.7%) had anisometropia.

Discussion

This study shows that uncorrected distant RE had a significant contribution to morbidity in patients attending a hospital eye clinic. The patients with distant refractive error, 221 (36.8%) were visually impaired (<6/12-3/60), while 91 (15.1%) (inclusive of those with aphakia) were blind (<3/60-NPL).

After correction of refractive error the number of patients with normal VA (>6/12) increased to 579 (96.3%), thus virtually doubling the number of patients with normal VA. Appropriate refraction and correction also reduced the number of patients with mild and moderate VI to 8 (1.3%) and 14 (2.3%) respectively. VI of < 6/12-3/60 was reduced to 22 (3.6%) and severe VI and blindness were completely eliminated just with refractive correction.

Table 4: Gender distribution of patients with anisometropia

Gender	≤1 D *N* (%)	>1-2 D *N* (%)	>2-3 D *N* (%)	>3 D *N* (%)	Total *N* (%)
Female	88 (80.7)	9 (8.3)	3 (2.7)	9 (8.3)	109 (100)
Male	81 (72.3)	17 (15.2)	8 (7.1)	6 (5.4)	112 (100)
Total	169 (76.5)	26 (11.8)	11 (5.0)	15 (6.7)	221 (100)

This confirms the point noted by others,[3-13] that RE is one of the simplest and most effective treatable causes of VI and blindness. Simple provision of corrective spectacles could have prevented 15.1% of blindness and reduced VI by 34.5% in this study group. The same effect has been found in various studies where correction of RE significantly reduced the burden of blindness. In India,[14] and in Brazil[15] the prevalence of blindness in older adults decreased with refractive correction. In school children, the prevalence of uncorrected visual impairment was reduced from 4.82% to 0.41% with refractive correction.[15]

In school-age-children, prescription and spectacle provision remains the most cost-effective means for addressing this readily treatable cause of VI and blindness, especially in developing nations. The Nigeria National Blindness and VI Study[12] also found improvement in VA post refraction in all categories of VI.

In the present study myopia was the most common RE seen among the patients. This was followed by astigmatism, and then hypermetropia and aphakia. This agrees with the previous clinical studies in the country and elsewhere, which show that myopia is the most common refractive cause of VI.[16-18] However, Ayanniyi *et al*[19] in a private optometry practice in Ado-Ekiti Nigeria and Bagaiya and Pam.[20] in Kaduna State North Central Nigeria among University community both found hypermetropia to be the commonest RE. The Nigeria National Blindness and VI Study,[12] a population based survey of those aged 40 years and above, found hypermetropia in 52.1% (95% confidence Interval (CI), 50.8-53.3%) when they excluded those with significant lens opacities. Their crude prevalence of myopia was 9.4% (95% CI, 8.7-10.2%) after excluding participants with lens opacities. The difference could be as a result of high student population in our study as opposed to population based survey with a cut off age of 40 years and above. Our hospital based study

however agrees with other studies in Africa and among black Africans who found myopia as the most common RE, but at a lower prevalence than what is seen among the European and South East Asian Nations.[21-26] The prevalence of myopia is on the increase world-wide and especially in the South East Asian countries.[24-26] Several risk factors such as genetics, family history of two myopic parents,[27] higher education, rise in socio-economic status, reduced exposure to outdoor sports/activities and increased near work have been associated with myopia; thus giving rise to the 'use-abuse' theory, which shows an increase in myopia with an increase in hours of near reading.[20,28-30] This being a retrospective and clinical study these factors were not probed into in detail.

When the spherical equivalent was taken into consideration there were more patients with low myopia than high and extreme myopia. High myopia was present in 0.7% and extreme myopia in 0.1% of the total patients in this study. Thus, high and extreme myopia was present in 0.8% of the study population. This is in agreement with the findings of 0.7% high myopia in the Nigeria National Blindness and VI Study.[12] Other population based surveys have shown myopia to increase with age.[12,31] This study shows an apparent increase with age in those between 11 years and 50 years, but a decrease thereafter. Myopia sometimes shows an increase in the early twenties, and sometimes later for those who get involved in more intensive studies later in life.[30] Nuclear lens scleroses later on in life could also lead to myopic shift in the 41-50 year olds.

Refractive errors were more evenly distributed among the females, with myopia (34.8%), astigmatism (33.2%) and hypermetropia (32.0%) having almost the same frequency. Fewer men (26.4%) had hypermetropia compared to females (33.2%). This compares favourably with the findings in the Bangladesh and the Nigeria National Blindness and VI Study and where myopia was found to be more common in men, and hypermetropia more common in women.[29,12] Though myopia is commoner in males, high myopia has been found commoner in females as seen in this study and the Bangladesh study.[29] The Bangladesh study also showed an association between myopia and higher education, and it was also commoner in those with office jobs than subjects without formal employment. This study found a similar association of myopia with those in civil service-those involved in 'white collar jobs' as opposed to the artisans. The Nigeria National Blindness and VI Study[12] however found higher prevalence of myopia among the illiterates, laborers, and rural dwellers.

In the case of hypermetropia, low and extreme hypermetropia was more prevalent. Aphakia contributed to the presence of extreme hypermetropia $\geq +10$ D. This study found patients in the age group 0-10 years had more hypermetropia and this agrees with previous studies.[16-20] Physiological hypermetropia occurs normally from birth to about 7 years; thereafter, with the changes in the axial length, cornea, and lens, the eye moves towards emmetropia and may even overshoot towards myopia.[33]

Students were also found to have more hypermetropia than myopia in the present study contrasting the "use-abuse" theory.

Astigmatism was seen more in the age group 11-20. More patients with RE had astigmatism WTR followed by, astigmatism ATR and then oblique astigmatism. This is the usual pattern in life whereby astigmatism WTR has a higher prevalence in the general population.[32,33] The study in Bangladesh adults however found more subjects with ATR astigmatism, followed by oblique astigmatism and then WTR astigmatism. They found ATR astigmatism and oblique astigmatism increased with age.[29]

The patients with RE had various degrees of anisometropia. The majority (76.5%) of them had anisometropia of ≤ 1 D and 16.8% had medium anisometropia (>1 to 3 D). Adeoti and Egbewale[34] found 57.7% with anisometropia of 0.25 D and 6.6% of 2 D and above in an Oshogbo hospital eye clinic, Nigeria among patients with RE. Low and high anisometropia was more among the females. The males had more of medium anisometropia. This is similar to the findings by Bourne[29] in a population based study. They found women more commonly with anisometropia of >1.0 D and it increased with age. Anisometropia in adults can significantly affect high grade binocular interactions and depth of perception.[35,36] The degree of anisometropia is important when it comes to the consideration of making mass production low cost spectacles. In this study about 76.5% of patients with ≤ 1 D anisometropia could benefit from such 'off-the-shelf' spectacle corrective glasses.

The study found uncorrected aphakia in 7 (1.2%) of patients with RE. With the advent of intraocular lens implant this may cease to be a problem.

This study shows that RE is a significant cause of Blindness and VI, and it could easily be corrected by the provision of spectacles.

Acknowledgments

We are very grateful to the management of Adoose Specialist Hospital for allowing us access, and the use of the patient records. Prof. AO Malu helped with proofreading of this manuscript and offering constructive criticism.

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How to cite this article: Malu K, Ojabo C. Refractive errors in patients attending a private hospital in Jos, Nigeria. Niger J Clin Pract 2014;17:106-11.
Source of Support: Nil, **Conflict of Interest:** None declared.