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Prevalence and pattern of refractive error in a tertiary health facility in southwest Nigeria

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Abstract

Background: Globally, uncorrected refractive error (RE) is a major cause of blindness, visual impairment (VI), and low vision.
Aim: To determine the prevalence, pattern, and level of visual impairment among clinic patients with refractive error in a tertiary health facility.
Methods: This was an analytical cross-sectional study conducted on patients who presented at a tertiary health facility in Ogun State, Nigeria. The biodata of the patients, level of education, occupation, the symptoms, and signs including the visual acuity (at presentation and after correction), and diagnosis were considered. Lenses that gave the patient the best vision were recorded as the type and magnitude of refractive error for that individual.
Results: The prevalence of RE was 10.6%. Children and adolescents comprised 23.3% of the cases of refractive error while traders comprised 17.1%. Those who did not have formal education were 3.7%. Blurring of vision for near was the most common presenting symptom. Normal visual acuity (6/6) and better was 33.4% at entry and 77.4% with correction. Myopia was observed to be the most common type of RE in children and adolescents. The prevalence of VI and blindness was 6.7%.
Conclusion: RE is a major cause of blindness and VI, with the prevalence of Myopia higher in age group thirty years and below: lack of formal education may be a barrier for uptake of refractive error services in population with low literacy level.

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Keywords: Nigeria, prevalence, refractive error, tertiary health facility, visual impairment

Kadar kelaziman dan corak ralat biasan di kalangan pesakit yang menghadiri pusat kesihatan tertiari di barat selatan Nigeria

Abstrak

Latarbelakang: Secara global, ralat biasan tanpa pembetulan merupakan penyebab utama kebutaan, cacat penglihatan dan penglihatan rendah.
Tujuan: Untuk menentukan kadar kelaziman, corak dan tahap penglihatan rendah di kalangan pesakit yang mempunyai ralat biasan di sebuah pusat kesihatan tertiari.
Kaedah: Ini merupakan kajian keratan rentas secara analitikal dijalankan ke atas pesakit di sebuah pusat kesihatan tertiari di negeri Ogun, Nigeria. Biodata pesakit, tahap pendidikan, pekerjaan, gejala dan tanda-tanda termasuk ketajaman penglihatan (semasa kehadiran yang pertama dan selepas pembetulan) dan diagnosis yang diberikan. Jenis dan magintud kanta yang memberi penglihatan yang terbaik direkodkan untuk setiap individu. Data yang diperolehi dicerakin dengan menggunakn SPSS versi 21.
Keputusan: Kadar kelaziman untuk ralat biasan adalah 10.6%. Kanak-kanak dan remaja menyumbang 23.3% untuk kes ralat biasan sementara pesakit tanpa pendidikan yang formal adalah 3.7%. Gejala paling biasa ialah kekaburan pada jarak dekat. Untuk kumpulan yang mempunyai ketajaman penglihatan yang normal dan lebih baik, kadar kelaziman adalah 33.4% di saat permulaan dan 77.4% selepas pembetulan dilakukan. Di kalangan kanak-kanak dan remaja, miopia merupakan ralat biasan yang kerap berlaku. Kadar kelaziman untuk cacat penglihatan dan kebutaan adalah 6.7%.
Kesimpulan: Ralat biasan merupakan penyebab utama kebutaan dan cacat penglihatan dengan kadar kelaziman miopia adalah tinggi dalam kumpulan berusia 30 tahun ke bawah. Kekurangan pendidikan yang formal mungkin menjadi benteng untuk peningkatan perkhidmatan ralat biasan di dalam populasi yang mempunyai kadar celik huruf yang rendah.

Kata kunci: astigmatisme, cacat penglihatan, kadar kelaziman, pusat kesihatan tertiri, miopia, ralat biasan tanpa pembetulan

Introduction

Refractive error (RE), also called ametropia, is failure of the eye's refractive system to focus images sharply on the retina, thus causing blurred vision in an otherwise normal eye. It is the second leading cause of avoidable/treatable blindness and visual impairment (VI) after cataract and the most common cause of optically corrected visual impairment and blindness. Globally, 2.3 billion people in the world suffer from poor vision due to RE, of which 670 million are considered visually impaired.[1] It is estimated that 153 million people are either blind or have low vision from uncorrected RE.[2]

RE is a significant cause of low vision in African countries but available data are limited.[3] In Nigeria, uncorrected RE along with cataract and glaucoma are the leading causes of blindness, VI, and low vision.[4] The Nigerian National Blindness and Visual Impairment survey indicated that uncorrected RE accounts for 57.1% of moderate VI.[4,5] RE affect all ages, gender, races, and professions.[2,6] Genetic and environmental factors play a role in the aetiology of RE.[7,8] The three main types of refractive errors, myopia, hypermetropia, and astigmatism, all have in common blurring of vision for far, near, or both, and other complaints depend on the type of RE the individual has.

Uncorrected RE is of public health importance because it can result in poor academic performance, and thus loss of education and employments opportunities, low productivity, and impaired quality of life.[2] The global burden in terms of annual economic loss is reported to be $269 billion dollars.[9] RE is thus a priority for the World Health Organization's (WHO) VISION 2020: The Right to Sight campaign. Prescription of appropriate corrective lenses is the treatment of choice,[2] which in the form of spectacles is one of the most cost-effective interventions in eye health.[4] There is paucity of regional and state data on RE, especially among the adult population, as well as studies that considered both children and adults in Nigeria. To the best of our knowledge, no study has been conducted on the prevalence of RE in our health facility. Uncorrected RE contributes to the burden of VI in communities, particularly in poor-resource parts of the developing world where access to specialized care is highly restricted by lack of awareness, low priority of eye care, poor availability of eye care facility, unaffordable cost, and poor accessibility of care.

The aim of this study was to determine the prevalence, pattern of refractive error, and level of VI among clinic patients in our health facility. Given that hospital-based studies represent the small proportion of people who present themselves for examination, the results may not reflect the true magnitude of the problem. However, the study may provide baseline information on the status of RE in the environment, and this information may constitute the basis for larger community-based research. The outcomes of this study may be used to plan an intervention program in the locality.

Methods

This is a cross-sectional, hospital-based study of consecutive patients who presented with symptoms and signs of RE at the Olabisi Onabanjo University Teaching Hospital (OOUTH), the only state-owned tertiary health facility in Ogun state, located in Sagamu local government in Remo. It serves all the people in the state and surrounding areas. Ethical approval for this study was obtained from the Ethics and Research Committee of the OOUTH.

All the patients who presented at the general eye clinic of the hospital between January 2016 and December 2017 were first seen and examined by the consultant ophthalmologists. Biodata regarding age, sex, level of education, and occupation were obtained. A detailed history was obtained for symptoms and duration, as well as history of spectacle use in patient and family members. Symptoms of blurring of vision for near included difficulty reading tiny letters, threading a needle, soldering of tiny things when repairing electronics or phones, and picking of beans at home. A thorough examination including the presenting visual acuity for far was done using the Snellen chart/Tumbling E chart and Lea symbol for the very young. Near vision was checked with a near vision chart, slit lamp biomicroscopic examination, and fundoscopy using either a direct or an indirect ophthalmoscope. Those who were suspected to have RE and those who had complaints with their glasses in the absence of any eye disease were referred to the refraction clinic.

The patients who presented to the eye clinic with symptoms and signs of RE in the absence of other ocular morbidities/comorbidities were included in the study, as were those who presented with issues with their glasses (broken, misplaced, or ineffective glasses, intolerability, scratched lenses, and poor vision even with glasses) in the absence of any eye disease; these latter patients were categorised as wanting to change their glasses. A combination of two or more of the following symptoms of redness, photophobia, eye ache and pain, closing and squeezing the eye in an individual was regarded as asthenopia.

Patients for whom the cause of poor vision was not RE were excluded, *i.e.*, cataract, cataract surgery, and cataract-related problems including aphakia and pseudophakia, glaucoma, and those with evidence of ocular disease.

Ages were categorized in groups of tens. Age groups 0–10 years and 11–20 years were regarded as children and adolescents; age groups 41–50 years and 51–60 years were categorized as middle aged; and those from age 71 years were categorized as elderly.

Objective refraction was obtained with the aid of autorefractometer and/or streak retinoscopy. All children 7 years and below had cycloplegic refraction with 1% atropine. Subjective refraction was done by interposing lenses using the trial frame, trial lenses, illuminated Snellen chart, and near vision chart. The lens that gave the patient the best vision was taken as the RE and was prescribed. Myopia was taken as spherical error of ≤ -0.50 D, hypermetropia was taken as spherical error of ≥ +0.50

D, while astigmatism was cylindrical error of ≥ 0.50 D cylinder. Simple spherical RE was taken as error of ≥ 0.50 to 5.00 D while high spherical error was taken to be >5.00 D. Simple astigmatic error was ≥0.50 to 1.00 D of cylinder and higher values were regarded as high cylinder. Even though some patients presented with more than one type of RE, the more significant RE based on the patients' complaints and needs were considered for analysis.

The intraocular pressure (IOP) was checked with Goldman applanation tonometry where indicated, and those with persistent IOP greater than 21 mmHg were referred for glaucoma screening. Data were generated and recorded in a spread sheet and analysed using SPSS version 21.

Highly skilled professionals were doctors, engineers, lawyers, nurses, teachers etc.; skilled professionals were tailors, brick layers, motor mechanics, etc.; and unskilled were food vendors, cleaners, etc.

Results

A total of 13,689 new patients including children were seen during the study period. Males were 6,204 (45%) while 7,485 (55%) were females with male-to-female ratio 1:1.2. There were 1,450 patients diagnosed with RE, with a prevalence of 10.6%. The age of the patients with REs ranged from 6 months to 86 years. Male-to-female ratio was 1:1.8. There were 223 children (6 months to 15 years), 32 (14.3%) less than 7 years. The gender, presenting symptoms, and magnitude of refractive errors are presented in Table 1. The level of education and occupation are presented in Table 2. The gender of three patients, presenting complaints of 16, and level of education in 177 patients were missing.

All types of REs were more common in females across all age groups except those 10 years and younger, where myopia was predominant among males. High astigmatism was more common in males than females. The frequencies of the different age categories with respect to their sex and type of RE are as shown in Table 3. The pattern of RE according to age categories is shown in Figure 1. High myopia was 2.7% while high hypermetropia was 0.9%. Simple myopic astigmatism predominated the types of astigmatism as shown in Table 4. There was very little difference in RE between both eyes. VI due to uncorrected RE based on presenting visual acuity was recorded in 920 (63.5%) patients, giving a prevalence of 6.7%. After best correction of the RE with lenses, the prevalence of VI according to the WHO definition was reduced to 2.2% (Table 5).

There were 864 (59.6%) patients who had presbyopia with and without underlying RE. IOP was greater than 21mmHg in the right eye of 28 (1.9%) patients and in the left eye of 24 (1.7%) patients. The highest recorded values were 44 mmHg and 35 mmHg in the right and left eye, respectively. Anisometropia of ≥ 2 DS was found in 28 (1.9%) patients

Table 1. Sociodemographic characteristics of the patients and magnitude of refractive error

Variables	Frequency	Percentage (%)
Gender		
Male	510	35.2
Female	937	65.6
Missing	3	0.2
Presenting complaints		
Blurring of vision for near	641	44.2
Blurring of vision for far	455	31.4
Asthenopia	119	8.2
Eye ache and pain	90	6.2
Blurring of vision for both far and near	74	5.1
Change of glasses	67	4.6
Watering/itching	25	1.7
Squint/double vision	24	1.7
Headache	12	0.8
Nystagmus	4	0.3
**Others	41	2.8
Missing	16	1.1
Magnitude of refractive error		
Astigmatism	490	33.8
Hypermetropia	467	32.2
Myopia	338	23.3
Presbyopia	155	10.7

**Others include photophobia, redness, foreign body sensation, squeezing of eyes, peppery sensation, and those who came for (vision test) eye screening for schooling and drivers' license.

Table 2. Occupations and level of education

Variables	Frequency	Percentage (%)
Occupation		
Student	289	19.9
Trader	248	17.1
Highly skilled professional	181	12.5
Retiree	104	7.2
Civil servant	66	4.6
Skilled professional	62	4.3
Farmer	40	2.8
Unskilled	33	2.3
Cleric	28	1.9
Level of education		
No formal education	53	3.7
Primary	162	11.2
Secondary	390	26.9
Post-secondary	103	7.1
University undergraduate	23	1.6
Tertiary	487	33.6
Postgraduate	34	2.3
Indeterminate	21	1.4
Missing	177	12.2

Table 3. Prevalence of refractive errors according to age category and sex

Age group (years)	SM		HM		SH		HH		A		HA		Total	%
	M	F	M	F	M	F	M	F	M	F	M	F		
0–10	20	14	04	02	11	12	01	02	06	14	03	00	89	6.1
11–20	18	76	05	10	13	42	00	00	20	54	02	09	249	17.2
21–30	17	20	03	02	01	14	02	00	12	12	06	01	90	6.2
31–40	04	14	00	03	17	33	02	01	22	24	03	02	125	8.6
41–50	09	19	01	02	46	96	00	01	39	66	08	05	292	20.1
51–60	17	22	01	03	32	77	01	00	30	46	02	02	233	16.1
61–70	11	12	01	01	16	33	00	01	25	24	04	05	133	9.2
71–80	09	11	01	00	06	04	01	00	10	12	10	02	66	4.6
81 ≥	02	02	00	00	01	01	00	00	01	01	01	02	11	0.7
Others*	01	01	00	00	00	00	00	00	01	02	01	01	07	0.4
Total	**108**	**191**	**16**	**23**	**143**	**312**	**07**	**05**	**166**	**255**	**40**	**29**	**1295**	**89.2**

SM: simple myopia; HM: high myopia; SH: simple hypermetropia; HH: high hypermetropia; A: astigmatism; HA: high astigmatism
**Others were those whose ages were not available.

Table 4. Frequencies of the different types of astigmatism with respect to age categories

Age group (years)	SMA	CMA	SHA	CHA	MA
0-10	6	6	2	4	5
11-20	39	20	8	8	10
21-30	8	10	7	2	4
31-40	17	12	11	4	7
41-50	36	13	26	32	11
51-60	19	9	14	26	12
61-70	9	11	9	22	7
71-80	9	6	3	7	9
81≥	1	1	0	1	2
Others*	2	1	1	0	1
Total (%)	146 (29.8)	89 (18.2)	81 (16.5)	106 (21.6)	68 (13.9)

SMA: simple myopic astigmatism; CMD: compound myopic astigmatism; SHA: simple hypermetropic astigmatism; CHA: compound hypermetropic astigmatism: MA: mixed astigmatism
*Others were those whose ages were not clearly documented.

Table 5. Magnitude of visual impairment before and after correction (uncorrected and corrected visual acuity)

Visual acuity	Uncorrected (%)	Corrected (%)
6/6 & better	483 (33.4)	1122 (77.4)
6/18-6/9 (mild VI)	582 (40.1)	249 (17.2)
6/60-6/24 (moderate VI)	231 (15.9)	40 (2.8)
3/60 5/60 (severe VI)	43 (3.0)	5 (0.3)
2/60 & worse (Blind)	64 (4.4)	7 (0.5)
Others*	47 (3.2)	27 (1.9)
Total VI	**920 (63.5)**	**301 (20.8)**

VI: visual impairment
*Others included preverbal children, those whose visual acuities could not be assessed, and those with either missing or illegibly documented visual acuities.

Discussion

The results of the present study show that RE was responsible for 10% of the total clinic attendance; more than 90% of these cases were uncorrected at presentation. RE affects all ages. Adolescents and adults comprised most of the patients, while children were less than one-fifth of the population study. The reason for the low presentation of children cannot be readily explained because it's beyond the scope of the study, but may be due to the theory of emmetropisation propounded by Flitcroft *et al.*[10] It could be because children are at the mercy of their parents for seeking eye health in developing countries. The reasons given by Velibanti *et al.* in Swaziland,[11] which included poor health literacy, parents not wanting their children to wear spectacles, socioeconomic factors, and lack of knowledge and awareness of existing eye care facilities, may be applicable to all developing countries including Nigeria. Those in middle age were the most represented in the study. Difficulty in reading because of presbyopia was responsible for the large number of patients attending the clinic in this age group.

Among the adult population, the elderly from age 71 years and older were least represented. The reason for this is that most of them did not meet the inclusion criteria due to the associated ocular comorbidities usually found in these age groups.

There were twice as many females as males in the study. This could be because many more females attended the general clinic (where those with RE were recruited), and by extension, attended the refraction clinic. On the other hand, the large number of females who were traders and highly skilled professionals may be able to explain these findings. This supports past studies that found that

more women access health and eye care facilities than men.[12, 13] Those who were traders and those on shift duties, who were predominantly females, might have found it easier to create time to access health and eye care to be able to function effectively in their duties. Possible reasons for reduced male attendance could be tight schedules and that males are more likely to attend private clinics, where the waiting time is shorter, during their own free time when they finish work. They are more likely to be able to afford the cost of private health care, which is usually higher than that of public health institutions. All types of REs were more common in females because of the same reason adduced earlier, although Yoo *et al.* found no sex difference in his study,[14] while Yekta *et al.* reported more males with RE in their study. [15]

Less than one-tenth of the study population had no formal education while one-third had tertiary education. This may mean that only those who could read and write were those who accessed eye care. These patients were more likely to have information about eye health, its availability and accessibility. The simple inference from this result is that access to eye care depends not only on availability and cost but also access to health information, which may be linked to educational attainment. The implication of this finding is that there are likely many more people in the community who may be blind or visually impaired from uncorrected RE but cannot access eye care due to lack of information and awareness. A community-based intervention study may be necessary to identify such people, and provide information on eye health and the need for use of appropriate spectacle in those who are blind or visually impaired from uncorrected RE if VISION 2020 is to be a reality.

Students dominated the population of those who presented for RE services in this study probably because the hospital where the study was conducted shares the same premises as the college of health sciences, where good vision is a requirement for good academic performance. This finding is similar to those in the study by Malu *et al.*, where students comprised the majority of those who accessed their refraction facility.[16]

Blurred vision for near was the most common presenting symptoms in this study. This can be explained by the large number of middle-aged and literates who were hypermetropic and presbyopic; these results are similar to those of Ayanniyi *et al.*[17] Less than 5% of the study population presented because they wanted to change their spectacles. This is a pointer to the fact that spectacle coverage is very low in semiurban Nigeria, where this study was conducted. It is possible that barriers to spectacle uptake may be an unidentified problem in this area. Ezelum *et al.*[4] reported similar findings, while change of spectacles was the most common reason for presentation in Ayanniyi's report.[17]

Anisometropia of ≥ 2.0 DS was very low compared with the findings of Malu *et al.*,[16] which is likely to be due to difference in the population and ethnicity of the two studies.

Astigmatism was the most common type of RE observed in this study, as similarly reported by other authors.[18,19] Even though the prevalence of astigmatism found by Rim *et al.* is similar, they reported it as second to myopia.[20] Contrary to our observation, Gomez-Salazar *et al.* found a decreasing trend in astigmatism with age.[21] Simple myopic astigmatism was the most common variant of astigmatism in this study. Myopic astigmatism (simple and compound) was the most prevalent type in children. A study done in Osogbo in Nigeria on RE in children also supported this finding.[22]

The distribution pattern of astigmatism and hypermetropia were similar in the different age groups, with dual peaks at 11–20 years and 41–50 years. The greater peak at 41–50 years may be related to the high proportion of hypermetropia and hypermetropic astigmatism, which make near work difficult. Vitale *et al.*[23] reported a very low prevalence of hypermetropia among the American population, as they studied hypermetropia of +3 D and higher, thus excluding a large proportion of those with lower error.

Myopia was the least common type of RE in this study, matching the findings of Ferraz *et al.*[24] Other studies found myopia to be the most common RE, and this was attributed to changes in lifestyle.[16,25-27] Myopia appeared to decrease with age, which has been similarly reported by Natung *et al.* in India[28] and Assefa *et al.*[29] Less myopia was recorded from age 41 years and older because people with myopia in these age groups are not likely to have reading difficulty, which was identified as an important reason for presentation. This defers from the study by Onua *et al.*[30] in Nigeria where highest prevalence was reported among the age 50–59 group, probably due to the community nature of their study.

High REs, especially myopia, were more common in this study than in reports from other authors.[4] Sarma *et al.* reported no case of high myopia in their study.[31] The reason was due to their classification of moderate myopia with spherical error extending to -6 00 DS, which was regarded as high myopia in this study.

VI was an important presentation of uncorrected RE in this study, evident by 63.4% of the study population with VI at presentation. This percentage was reduced to 20.8% after correction with appropriate lenses. The relatively low prevalence of VI of 6.7% was due to the hospital-based nature of this study. A study done in Onitsha[32] reported a similar prevalence of VI due to RE, but it was conducted among school children. A prevalence of 9% was reported by Reidy *et al.*[33] in a community-based study in North London, while a much lower prevalence was reported by Resnikoff *et al.*,[2] who categorized their findings according to age group. A larger community-based study will be needed to reveal the true prevalence of VI induced by uncorrected RE in our area. Improvement in best-corrected visual acuity was recorded in all the different stages of VI, as reported by Ferraz *et al.*[34]

One of the limitations of the study was its hospital-based nature, which may not capture the real magnitude of uncorrected RE in our area; thus, this report might just represent the tip of the iceberg. Another limitation was the poor, inadequate,

and illegible documentation in the patients' case notes, which made access to all the needed information difficult and was responsible for most of the missing data.

In conclusion, the prevalence of RE remains high at 10.6%; myopia peaked in the teenage years and declined gradually with increasing age, while hypermetropia and astigmatism have dual peaks, which corresponded with middle age. Some of the recommendations to reduce the burden of uncorrected RE would be increasing its awareness and taking refraction services to the rural underserved communities with a view to making spectacles (low cost but durable) available and affordable by all.

Declarations

Ethics approval and consent to participate

Ethical approval for this study was obtained from the Ethics and Research Committee of the Olabisi Onabanjo University Teaching Hospital (OOUTH).

Competing interests

None to declare.

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None to declare.

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