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Prevalence and patterns of refractive error among adults in Sagamu, South-West Nigeria

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Background: The study was part of community-based research towards strengthening the provision of optical services within a local governmental area in Nigeria.

Aim: To describe the prevalence of refractive errors in the southwestern Nigerian adult population.

Setting: Adults of age 30 years and above who were regular residents of the local governmental area.

Methods: A multistage stratified random cluster sampling method was used to select the subjects. The sampling unit was the different households. A random sample of them were refracted and then refractive errors were analysed. Analyses excluded participants with history of cataract surgery. Associations with myopia (−0.50 dioptres [D] or more) and hyperopia (≥ 0.50 D) were evaluated in logistic regression analyses.

Results: The prevalence of refractive error in the study sample was 33.8% (95% confidence level [CI]: 27.1–34.4) using study participants with < 6/9 presenting visual acuity but improvement by at least a line with pin hole. The prevalence of hyperopia was 46.9% and higher in women (51.8%), while that of myopia was 21.9% but higher in men (25.0%). The prevalence of hyperopia increased from 29% for 40–49 years of age to 65% for 50–59 years of age and tended to decline thereafter. Prevalence of myopia decreased from 17% in persons 40–49 years of age to 11% in those 50–59 years of age but increased after 60 years of age. A higher prevalence of myopia was positively associated ($p < 0.05$) with lifetime occupations requiring near work, nuclear opacities, posterior subcapsular opacities and glaucoma. Factors associated with hyperopia were the same as for myopia, except for occupation, and in the opposite direction.

Conclusion: The high prevalence of refractive errors strongly supports the need for an affordable and accessible optical service in the local government.

Keywords: prevalence of refractive errors; hyperopia; myopia; adult refractive state; Nigerian public health.

Introduction

Uncorrected refractive error (URE) is one of the priority areas for the World Health Organization (WHO) Global VISION 2020: The Right to Sight initiative.[1] Globally, URE is a major cause of moderate and severe visual impairment (VI) and the second leading cause of blindness, accounting for over 153 million and eight million affected persons, respectively, although correction of refractive error with appropriate spectacles is one of the most cost-effective interventions in eye health.[2] Although URE is said to be a significant cause of low or partial vision in African countries, available data are limited.[3] Yet studies for different areas on URE are essential, as the African population is widely varied in terms of eye care penetration and ancestry.[4] One of the strategies to achieve the overall aim of the WHO action plan for refractive errors is to assess the prevalence of refractive errors and presbyopia where data are lacking and explore the optimal means of delivering services that are acceptable and cost-effective.[2]

Several population-based studies have been carried out in other parts of the world,[4,5,6,7,8,9,10,11] while most studies in Nigeria have been hospital-based,[12,13,14,15,16,17] with few population-based studies.[18,19,20]

The prevalence of refractive errors has been shown to vary with ethnicity and race. In Singapore, the overall prevalence of myopia (38.7%), hyperopia (28.4%) and astigmatism (37.8%) was found

with high myopia (–5.00 dioptres [D] or more) being 9.15%.[5] Studies in India[6] and Bangladesh[7] showed prevalence of 29% and 22%, respectively. In Tema, Ghana,[8] the prevalence of VI decreased from 17.1% to 6.7% after refraction and spectacle correction, suggesting that URE was the major correctable cause of VI.

In 2007, the Nigerian National Blindness and VI Study[18] discovered that URE was responsible for 77.9% of mild VI, 57.1% of moderate VI, 11.3% of severe VI and 1.4% of blindness in the country, with myopia being more prevalent. There is an urgent need to improve refractive error and spectacle coverage in Nigeria by prompt incorporation of primary eye care into the existing primary health care system, as done in several countries. For example, eye care services in Brazil are provided under their National Social Security System. while in Oman, primary eye care has been fully integrated into their primary health care system. This study aimed to determine the prevalence and pattern of URE in Sagamu, Ogun State, Nigeria.

Research methods and design

This was a community-based study conducted among the adult population of Sagamu local government area of Ogun State. The age of the participants was from 30 years and above. The study took place from September to November 2012, which was a period of 10 weeks. Ethical approval was obtained from the institutional review board of the authors' institution. Despite the long delay from collection to analysis, publication of this data was considered relevant.

Inclusion and exclusion criteria

All individuals aged 30 years and above who had been resident in the study area for at least six months were enumerated and invited to participate in the study. The following additional exclusion criteria were used:

- Individuals with corrected distance visual acuity of less than 6/60.
- Inability to test vision, although the individual was not blind.
- Debilitated or severely ill individuals.
- Those unwilling to participate in the study.

A multistage stratified random cluster sampling method was used to select the subjects. The minimum sample size was calculated to be 700, and the sampling unit was the households, which included all adults that lived under the same roofs. The political wards in the local government area were stratified into urban and rural. Twelve of these wards were urban while three were rural. Four urban wards and one rural ward were then selected by balloting. These five wards were divided into settlements, and the ones to be included were determined by systematic random sampling. In each settlement, 50 individuals aged 30 years and above who had been resident in the selected settlements for at least the previous 6 months were enumerated. A total of 700 participants were thus selected. Each eligible individual was given an identification form to bring to the examination centre, where interviews using standardised semistructured questionnaires and examinations including ocular refractions were performed. The questionnaire included age, gender, marital status, occupation, ocular symptoms, ocular signs (including visual acuity) and anterior and posterior segment findings. (The questionnaire was pretested at a community not chosen during sampling.) Distance presenting visual acuity (PVA) of each eye was tested separately and then binocularly, using the tumbling E chart at 6 m in ambient outside illumination under a shade. The corrected visual acuities were also recorded.

The examinations were carried out within 2–3 days of the enumeration exercise at a central and conducive place in the community. Further details of the sampling method are contained in an earlier publication[21] on other aspects of the study aimed at getting to know the local government population before establishing a programme for refractive error and spectacle coverage.

Detailed ocular examination

All participants had external examinations, including pupillary response. These were performed by the principal investigator (PI) and the junior resident, using a pen torch. Then all participants with visual acuity less than 6/6 had further examination to determine the cause of VI, which also included direct ophthalmoscopy to assess lens status and the posterior segment. Intraocular pressures were not measured, but those with suspicious discs were referred. All participants with visual acuity less than 6/9 who had shown at least a line improvement with pinholes had autorefraction done. The noncycloplegic automated refraction was carried out by one of the junior ophthalmology residents, who had been trained in its use. The autorefractor-keratometer used was the HRK 7000, which was calibrated at regular intervals. Five readings were taken for each eye, and averages were recorded.

Myopia was defined as a refractive error of –0.50 D or more, hypermetropia as 0.50 D or more and astigmatism as –0.50 D or greater, using negative cylinder format.[4] Those with spherical (or spherical equivalent) errors greater than ± 5.00 D were regarded as having high refractive errors.[4] Thereafter, distance subjective refractions were done using corresponding autorefraction results for participants as baseline values. Because of time constraints, astigmatic errors were not corrected and only the spherical equivalents were used.

Data analysis

The data were entered by the PI and analysed with the help of a statistician using the Statistical Package for Social Sciences (SPSS) version 16 statistical software. Frequencies and means were generated, and further analysis was done using cross tables, chi-square tests, odds ratios and multiple regression analyses to evaluate the associations between

refractive error and age, gender, education, domiciles (residences) and occupation.

Results

Of the 700 enumerated participants, 607 completed the face-to-face interview and examination, giving a response rate of 86.7%. Thirty-six (5.1%) participants were not available on the examination day, while 57 (8.1%) were not eligible based on exclusion criteria. The age of the participants ranged between 30 and 86 years, with a mean of 49.7 ± 11.4 years. Most participants (192, 31.2%) were in the 40–49 years age group, while only five (0.8%) were 80 years and above in age. Around 368 (60.6%) participants were female, giving a male to female ratio of 1:1.5. The female preponderance was observed in almost all the age groups except in the 70 years and above age groups, where the female to male ratio was 1:1. The male participants were significantly older than their female counterparts ($p = 0.017$).

As indicated in Table 1, and in terms of gender, there is a significant difference in the level of education of the study participants. While most of the female participants had completed primary school only, most male participants had postsecondary school qualifications. With respect to occupations, most female participants (168, 45.7%) were partially skilled workers, while most male participants (89, 37.2%) were manually skilled. Overall, a total of 569 (93.7%) participants were employed. Around 389 (64.1%) participants resided in the urban area of the local government, while 218 (35.9%) participants resided in the rural area.

TABLE 1: Distribution of educational status, occupations and place of domicile.

Characteristics	Male		Female		*p*
	n (239)	%	*n* (368)	%	
Level of education					0.001
No formal	27	11.3	81	22.0	
Primary school completed	65	27.2	112	30.4	
Secondary school completed	62	25.9	83	22.6	
Postsecondary school level	85	35.6	92	25.0	
Occupation					0.000
Professional	64	26.8	89	24.2	
Nonmanual skilled labour	26	10.9	27	7.3	
Manual skilled labour	89	37.2	55	14.9	
Partially skilled labour	29	12.1	168	45.7	
Unskilled labour	15	6.3	6	1.6	
Unemployed	16	6.7	23	6.3	
Domiciles					0.050
Urban	142	59.4	47	67.1	
Rural	97	40.6	121	32.9	

TABLE 2: Ocular symptoms of the 607 participants (multiple responses were given by some participants).

Ocular symptoms	Frequencies	%
Poor distance vision	249	41.0
Poor near vision	346	57.0
Ocular aches	156	25.7
Ocular watering	136	22.4
Foreign body sensation	68	11.2
Ocular itching	195	32.1
Headaches	108	17.8
Double vision	105	17.3
Other symptoms	5	0.8

Ocular symptoms of the participants

Around 553 (91.1%) participants had ocular complaints, while 54 (8.9%) did not have any eye complaint. Table 2 shows the distribution of ocular symptoms among those who gave a positive history (many participants had more than one complaint). The commonest ocular symptom reported was poor near vision (347, 57.0%).

Examination findings

Presenting vision in 403 (66.4%) participants was normal (≥ 6/9) as shown in Table 3. Around 115 participants (18.9%) had mild VI (< 6/9–6/18), 79 (13.0%) had moderate VI (< 6/18–6/60), zero (0.0%) had severe VI (< 6/60–3/60) and 10 (1.6%) were blind (< 3/60) in their better eyes.

After correction, 508 (83.5%) participants had normal vision, 65 (10.7%) mild VI, 34 (5.6%) moderate VI, zero (0.0%) severe VI and one (0.2%) was blind in the better eye (Table 3).

Around 320 (52.7%) participants had no abnormal findings, while 287 (47.3%) had ocular disease(s) (Table 4). The commonest condition was cataract in 191 (31.4%) study participants, followed by glaucoma in 30 (4.9%) and glaucoma suspects in 23 (3.8%).

Prevalence of refractive error

A total of 205 study participants who had PVA of < 6/9 and who had at least a line improvement with pinhole had automated refraction done. The prevalence of refractive error in the study sample was 30.6% (95% confidence interval [CI]: 27.1–34.4). Hyperopia was the commonest refractive error, with a prevalence of 20.4% (95% CI: 17.4–23.8), followed by myopia 7.9% (95% CI: 6.0–10.3) and astigmatism 3.1% (95% CI: 2.0–4.9). Four hundred and three participants (66.3%, 95% CI: 62.4–69.9) were listed as emmetropic (PVA ≥ 6/9). Nineteen study participants (3.1%) had no autorefraction reading due to lens opacity. Around 574 participants (75.3%) were isometric, while 34 (24.7%) had anisometropia. Figure 1 shows the prevalence of the different refractive states.

TABLE 3: Presenting and corrected distance visual acuities (at 6 m).

Visual acuity	Presenting visual acuity		Corrected visual acuity	
	n	%	*n*	%
6/4	23	3.8	34	5.6
6/5	122	20.1	178	29.3
6/6	174	28.7	220	36.2
6/9	84	13.8	75	12.4
6/12	46	7.6	34	5.6
6/18	69	11.3	31	5.1
6/24	55	9.0	24	3.9
6/36	22	3.6	9	1.5
6/60	2	0.3	1	0.2
< 3/60	10	1.7	1	0.2
Totals	**607**	**100.0**	**607**	**100.0**

TABLE 4: Ocular findings in the 607 study participants, in order of greatest occurrence.

Ocular findings	Frequencies	%
No findings	320	52.7
Cataract	191	31.5
Glaucoma	30	4.9
Glaucoma suspect	23	3.8
Pterygium	15	2.5
Allergy	8	1.3
Chorioretinal scar	5	0.8
Optic atrophy	4	0.7
Corneal scar	3	0.5
Pinguecula	3	0.5
AMD	3	0.5
Proptosis	1	0.2
RP	1	0.2
Total	**607**	**100.0**

AMD, age-related macular degeneration; RP, retinitis pigmentosa.

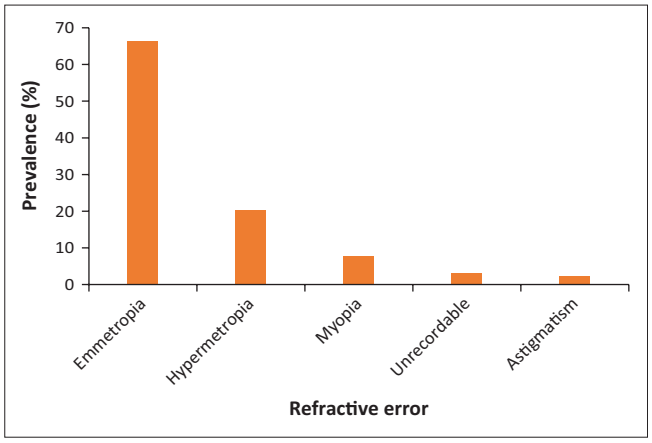

FIGURE 1: Prevalence of refractive states.

Table 5 shows that the age group 30–39 years is negatively associated with hyperopia ($p < 0.0001$, odds ratio [OR]: 0.18), while there was a positive association between hyperopia and 50–59 years age group ($p < 0.0001$, OR: 3.59). Attaining primary school education was positively associated with hyperopia ($p = 0.0476$, OR: 1.60) while being a nonmanual skilled worker was negatively associated with it ($p = 0.0476$, OR: 0.39). There is no statistically significant association between hyperopia and gender or place of domicile.

The 80 years and above age group ($p = 0.0041$, OR: 18.60) showed a statistically significant positive association with myopia, while there was a negative association between the 40 and 49 years age group ($p = 0.006$, OR: 0.23) and myopia. There was no statistically significant association between occupation, gender or place of domicile and myopia.

Discussion

Six hundred and seven participants completed the face-to-face interview and eye examinations, giving a response rate of 86.7%. This was a good response rate, and it compares favourably with the south-western response rate of 88.8% obtained in the Nigerian National Blindness and Visual Impairment Study.[18]

TABLE 5: Association between sociodemographic factors and hyperopia.

Variable	Hyperopia				*p*	OR	CI	
	Present		Absent				Lower	Upper
	n (123)	%	*n* (485)	%				
Age (years)								
30–39	7	5.5	120	94.5	0.0001*	0.18	0.08	0.40
40–49	32	16.7	160	83.3	0.1581	0.71	0.46	1.11
50–59	50	33.6	99	66.4	0.0001*	3.59	2.37	5.45
60–69	27	24.3	84	75.7	0.2410	1.34	0.83	2.19
70–79	6	25.0	18	75.0	0.6031	1.33	0.52	3.43
80 and above	1	20.0	4	80.0	1.0000	0.99	0.11	8.90
Gender								
Male	41	17.2	198	82.8	0.1480	0.73	0.48	1.20
Female	82	22.2	287	77.8	0.1480	0.73	0.48	1.20
Education								
No formal	22	20.4	86	79.6	1.0000	1.01	0.60	1.69
Primary	46	25.8	132	74.2	0.0346*	1.60	1.05	2.43
Secondary	22	15.2	123	84.8	0.0970	0.64	0.40	1.06
Postsecondary	33	18.6	144	81.4	0.5794	0.87	0.56	1.35
Occupation								
Professional	32	20.9	121	79.1	0.8165	1.06	0.67	1.66
Nonmanual skilled	5	9.4	48	90.6	0.0476*	0.39	0.15	0.99
Manual skilled	31	21.5	113	78.5	0.6371	1.11	0.70	1.75
Partially skilled	45	22.7	153	77.3	0.2840	1.25	0.83	1.89
Unskilled labour	5	23.8	16	76.2	0.5921	1.24	0.45	3.46
Unemployed	5	12.8	34	87.2	0.3041	0.56	0.22	1.47
Domiciles								
Urban	82	21.0	308	79.0	0.5298	1.15	0.76	1.75
Rural	41	18.8	177	81.2	0.5298	1.15	0.76	1.75

OR, odds ratio; CI, confidence interval.
*, Statistically significant. Sum is across the rows.

The mean age of the participants (49.7 ± 11.4 years with a range of 30–86 years) was higher than that obtained by Onabolu et al.[22] in a population-based study of effect of axial length on refractive error carried out in the same local government area. However, her study was among adults aged 18 years and above, while the present study was among adults 30 years and above.

The mean age for male participants was statistically higher than that of female participants. This has been observed also by other researchers.[18,22,] There was a female preponderance with a female to male ratio of 1.5:1, and this was similar to the study by Onabolu et al.[22] Importantly, this finding is in the demographic data of Sagamu local government area.[23]

At least 82.8% of the study participants had completed primary school education, while only 17.8% had no formal education. The proportion of those without formal education was higher in female participants compared to their male counterparts. This finding is in keeping with the findings of the 2006 Census which showed that there were more literate men than women across all age groups in Ogun State.[24]

Around 569 (93.6%) of the study participants were employed, while only 39 (6.4%) were unemployed. The percentage of those unemployed is lower than that for the state as of 2009. [24]

TABLE 6: Associations between sociodemographic factors and myopia.

Variables	Myopia present		Myopia absent		*p*	OR	CI	
	n (48)	%	*n* (560)	%			Lower	Upper
Ages (years)								
30–39	12	9.4	115	90.6	0.4616	1.29	0.65	2.56
40–49	5	2.6	187	97.4	0.0006*	0.23	0.09	0.60
50–59	10	6.7	139	93.3	0.6038	0.8	0.39	1.64
60–69	14	12.6	97	87.4	0.0509	1.97	1.02	3.80
70–79	4	16.7	20	80.3	0.1124	2.46	0.8	7.50
≥ 80	3	60.0	2	40.0	0.0041*	18.6	3.02	114.20
Gender								
Male	20	8.4	219	91.6	0.7593	1.11	0.61	2.02
Female	28	7.6	341	92.4	0.7593	1.11	0.61	2.02
Education								
No formal	16	14.8	92	85.2	0.0056*	2.54	1.34	4.83
Primary	8	4.5	170	95.5	0.0478*	0.46	0.21	1.00
Secondary	8	5.5	137	94.5	0.2896	0.62	0.28	1.35
Tertiary	16	9.0	161	91.0	0.5105	1.24	0.66	2.32
Occupations								
Professional	16	10.5	137	89.5	0.2238	1.54	0.82	2.90
Nonmanual skilled	4	7.5	49	92.5	1.00	0.948	0.33	2.75
Manual Skilled	6	4.2	138	95.8	0.0752	0.44	0.18	1.05
Partially skilled	19	9.6	179	90.4	0.3353	1.39	0.76	2.54
Unskilled	0	0.0	21	100.0	0.3982	-	-	-
Unemployed	3	7.7	36	92.3	1.00	0.97	0.28	3.28
Domiciles								
Urban	34	8.7	356	91.3	0.3500	1.39	0.73	2.65
Rural	14	6.4	204	93.6	0.3500	1.39	0.73	2.65

OR, odds ratio; CI, confidence interval.
*, Statistically significant. The sum is across the rows (horizontal axis).

About 91.1% of the study participants had ocular complaints as seen in Table 2. This could be a true reflection of the prevalence of eye problems in the community or could have been influenced by the fact that the participants were hoping to get some free treatment. Poor vision as the commonest ocular symptom is expected because of the age group studied.

At presentation, using the PVA, 66.5% (404) of the study participants had normal vision, 18.9% (115) had mild VI, 13.0% (79) had moderate VI, none had severe VI, but 1.6% (10) were blind. The proportion of those with normal vision was lower than that observed by Onabolu et al.[22] in their study. This may be because these studies involved younger adults 15 years and above. It is, however, like the 79.5% obtained in the south-western geopolitical zone by the Nigerian National Blindness and Visual Impairment Study group.[18] Using best corrected visual acuity, 83.5% (508) had normal vision, 10.7% (65) had mild VI, 5.6% (34) had moderate VI and 0.0% (0) had severe VI. The increase in the magnitude of VI when using the PVA had been documented by other researchers,[18,22] and it further lends support to the use of the revised grading of VI and blindness as proposed by the WHO.[25] Cataract is the commonest ocular pathology seen among the study participants with severe VI and blindness. This finding is like that of the Nigerian National Blindness and Visual Impairment Study[18] and other researchers.[26,27]

Prevalence of refractive error

The overall prevalence of refractive error in this study sample was 30.6%. This is lower than 79.1% reported by Onabolu et al.,[22] in their study. This may be because only those with presenting visual acuities < 6/9 who had shown improvement with pinhole were refracted in this study, while all subjects were refracted in the other study. It may also be due to the difference in the age of the participants; this study involved the 30 years and above age group while the other two studies involved 15-year-olds and above. It is, however, higher than the prevalence of between 10.7% and 15.4% reported by two other researchers[26,27] in south-western Nigeria.

Hyperopia was the commonest form of refractive error, seen in 20.4% of the participants. This is like the prevalence of between 19.7% and 23.3% reported by other investigators.[12,14] It is, however, lower than prevalence of 50.7% reported by the Nigerian National Blindness and Visual Impairment Survey Group.[18] There was an increase in the prevalence of hyperopia from 30 to 59 years, after which there was a decline in its prevalence (Table 5); this was similar to the findings of other investigators.[4,7,24] However, another study had also documented no statistically significant association between hyperopia and age[22] or increased occurrence with decreasing age.[4,7] There was no significant association between the prevalence of hyperopia and gender, educational background, occupation or place of residence, similar to the findings previously documented.[5]

The approximate prevalence of myopia in this study was 7.9%, comparable to that of 11.9% documented by Onabolu et al.,[22] but lower than that documented by other studies in which the same value of −0.50 D or worse was deemed significant.[4,5,7] The low prevalence observed in this study compared to the other studies may be due to racial difference between this study and some of the others. This racial difference of lower prevalence of myopia in black people compared to the other races had been highlighted by previous studies.[4,9]

There was a steady increase in the prevalence of myopia from 10.6% in the 60–69 age group to 60% in the 80 years and above age group (Table 6). This is similar to the findings documented by previous studies which found higher occurrence of myopia in older age groups.[4,7] This could be attributed to the increased likelihood of nuclear sclerosis and posterior capsular cataract seen in respondents older than 60 years.[6,10]

The prevalence of myopia in the professionals is higher than that observed in other group of workers, although this is not statistically significant. Some studies have also found that professionals are more likely to be myopic.[5]

This study, being population-based, had a more reliable prevalence rate of refractive error for those sampled. However,

the age range covered limits its interpretation for the whole population in the area. Autorefractions were done only in those with pinhole-improved visual acuity, which may have resulted in underestimation of the prevalence of refractive errors, although the gross data are believed to be relevant for planning.

Conclusion

With a high prevalence rate of 30.6% for refractive errors in this population sample, provision of a sustainable health education programme with robust and affordable facilities for refractive error corrections should be established as a matter of priority. This will require integration of primary eye care which includes optical services into the existing primary health care.

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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

This was a departmental study in which the three authors (H.A.A., V.O.F. and O.T.B.) were involved from the commencement to analysis, as indicated earlier.

Ethical considerations

Ethical clearance to conduct this study was obtained from the Olabisi Onabanjo University Teaching Hospital, Health Research Ethics Committee (ref. no. OOUTH/DA.326/795).

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Data availability

Data supporting the findings of this study are available from the corresponding author, H.A.A., on request.

Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of any affiliated agency of the authors.

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