Original Article

# Uncorrected Refractive Error in a University Community

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**Aims and Background:** To determine the prevalence and pattern of uncorrected refractive error among staff of a Nigerian university. **Patient and Methods:** A cross-sectional study of consecutive staff of the University of Nigeria, Nsukka, Nigeria who presented for a 10-day free eye screening program. Demographic data and data on eye care awareness and knowledge were obtained with a combination of self-administered and interviewer-administered questionnaires in the English language. Clinical examinations included visual acuity taken at 6 m with Snellen's chart; noncontact tonometry; pen-torch eye examination; and direct ophthalmoscopy; autorefraction and subjective refraction. **Results:** One thousand and eighty-three subjects aged 18–82 years (mean = 44.1 ± 12.15 years) comprising 568 females (52.4%) and 515 males (47.6%) were screened. Eighty-nine subjects (8.3%) were visually impaired and five subjects (0.5%) were blind. Three hundred and fifty-six subjects were diagnosed with refractive error (356/1083; 32.9%), out of which 149 subjects (41.9%) were uncorrected. The prevalence of uncorrected refractive error in this study population was 13.8%. Astigmatism was the commonest refractive error, whereas hypermetropia and hypermetropic astigmatism were the commonest spherical and astigmatic errors, respectively. **Conclusion:** A significant proportion of the staff of this Nigerian university still lives with uncorrected refractive error with its attendant consequences. Regular eye checks should be done by the staff of our universities and effort should be intensified in eye care awareness creation among the populace, including the apparently enlightened communities.

**Keywords:** *Ametropia, astigmatism, autorefraction, community, hypermetropia, myopia, ophthalmoscopy, refraction, refractive error, tonometry, uncorrected, university*

**Received:** 13-Jun-2021;
**Revision:** 24-Oct-2021;
**Accepted:** 09-Feb-2022;
**Published:** 16-Mar-2022

## Introduction

Refractive error otherwise called ametropia exists when distant objects are not focused sharply on the retina by an eye with relaxed accommodation.[1] Refractive errors comprise myopia, hypermetropia, and astigmatism. Astigmatism may further be classified as hypermetropic astigmatism, myopic astigmatism, mixed astigmatism, or irregular astigmatism.[2]

Uncorrected refractive error with the attendant visual impairment results in decreased quality of life for millions of people worldwide irrespective of age, sex, and ethnicity.[3] Globally, uncorrected refractive error is the leading cause of moderate and severe visual impairment,[4] and it was a priority area for VISION 2020: The Right to Sight initiative.[5] Uncorrected myopia has been found by some researchers to be independently associated with decreased quality of life and visual function.[6] In Nigeria, about four out of every 10 adults who are visually impaired are due to refractive error.[7] Bekibele had earlier found a prevalence of 17% for refractive error among drivers in public institutions[8] in Ibadan.

Access this article online

Quick Response Code:

Website: www.njcponline.com

DOI: 10.4103/njcp.njcp_1603_21

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**How to cite this article:** Anajekwu CC, Kizor-Akaraiwe N. Uncorrected refractive error in a university community. Niger J Clin Pract 2022;25:361-7.

The prevalence of uncorrected refractive error is influenced by strong socioeconomic factors such as age, sex, socioeconomic class, and level of education[9] In Kano, Nigeria, refractive error was found to be commoner in females.[10] Race has also been found to play a role in the prevalence and pattern of refractive errors.[11] The prevalence of myopia and hypermetropia was found to be significantly higher in the Whites and other colored races than in Blacks in a study in three communities in Cape Town, South Africa.[11] Astigmatism, however, showed no significant difference among the races.[11] The prevalence of myopia has been found to increase steadily with age in children and young adults.[2] Adult-onset myopia begins at about 20 years of age and extensive near work has been implicated as a risk factor. A study in West Point cadets, in New York, United States of America found myopia requiring corrective lenses in 46% at the entrance, 54% after 1 year, and 65% after 2 years.[2] The probability of myopic shift was, however, related to the degree of initial refractive error and age, with older subjects having a lower rate of myopic development.[2]

The prevalence of hypermetropia in adults appears to increase with age.[11] In Caucasians, the prevalence of adult hypermetropia increases from about 20% among those in their 40s to about 60% among those in their 70s and 80s.[2] A similar pattern of prevalence was seen among African Americans in Baltimore.[2] The prevalence has also been found to be higher in females by some studies.[11,12]

This study was aimed to determine the prevalence and pattern of refractive errors among the staff of a Nigerian university, an apparently educated community that engages in a lot of reading, with a view to proffering solution to this vital cause of decreased quality of life and visual functioning in this group of individuals and other similar groups.

## Materials and Methods

The study was a cross-sectional survey of consecutive staff of the University of Nigeria Nsukka, Nigeria who took part in a 10-day free eye screening at the University premises. Approval was obtained from the Vice-Chancellor of the university prior to the screening. Awareness for the eye screening was created through notices on notice boards and personal letters/emails to staff in all the faculties by the University's public relations officer (PRO). The notices contained the schedule and venue for the screening for different faculties.

Three to four faculties were merged for each day, with a central screening point. Screening was done free of cost to all participants. Those who could not attend on the appointed day for their faculties were encouraged to join any other faculty throughout the screening exercise.

During the screening, participants' sociodemographic characteristics, attitude, and practice of routine general eye checks, awareness, and knowledge of glaucoma were recorded in a questionnaire (Part A), whereas ocular findings were entered by ophthalmologists (Part B). Questionnaires were self-administered, except for those who could not read properly, which were interviewer-administered.

Clinical assessment included visual acuity (Snellen's chart), intraocular pressure measurement (noncontact tonometry-NCT Huvitz HNT 7000); anterior and posterior segments examinations with the pen-torch light, and direct ophthalmoscope, respectively; autorefraction and subjective refraction.

The visual acuity was measured using Snellen's chart placed in a lighted environment and read at 6 m. Participants' visual acuities were grouped into normal vision, mild visual impairment, moderate visual impairment, severe visual impairment, and blindness based on the World Health Organization (WHO) classification of visual impairments.[13]

Those diagnosed with refractive errors and already using eyeglasses but with improved visual acuities with pinholes were sent for refraction and better spectacle corrections were given. Those who did not have glasses but had better visual acuities with pinholes were sent for refraction and glasses were recommended thereafter. Participants having visual acuities worse than 6/60 were further evaluated with dilated funduscopy to ascertain the causes of poor vision and referred appropriately.

Participants who complained of problems with near vision also had refraction, and proper distance and near corrections were recommended where necessary.

Refraction was done with an autorefractor followed by subjective refraction by two experienced Optometrists using a trial lens frame and trial lenses. This was then followed by presbyopic correction as necessary using a Times Roman font near the chart.

After examination, definitive diagnoses were made. Participants with diagnoses that needed further clinical evaluation or follow-up were referred to an eye hospital located in the same town as the institution. Participants with apparent good eye health were encouraged to do an eye check in a year to ensure normalcy.

Ethical approval for the study was obtained from the Ethics Review Committee of ESUT Teaching Hospital Parklane,

Enugu, Nigeria. The study abided by the guidelines of the Declaration of Helsinki in the study with human subjects. Approval was also obtained from the management of the University of Nigeria, Nsukka, Nigeria.

For the purpose of this study, emmetropia was defined as spherical or astigmatic errorless or equal to ± 0.25 D.[14] Myopia was defined as spherical error greater or equal to −0.50 D;[14] hypermetropia was defined as spherical error greater or equal to +0.50 D,[14] whereas astigmatism was defined as astigmatic error greater or equal to ± 0.50 D.[14]

Presbyopia was defined as at least a step improvement in near visual acuity with the addition of a convex lens, with distance correction where necessary.[15]

Data were analyzed using IBM Statistical Package for Social Sciences (SPSS) version 22. Means and standard deviations were calculated for quantitative variables, whereas frequencies and percentages were calculated for qualitative variables. The presence of associations between uptake and demographic attributes such as age, sex, and educational level were tested using the Chi-square test. All *P* values reported are two-tailed and significance was defined as $P < 0.05$.

## Results

One thousand and eighty-three (1,083) participants comprising 568 (52.4%) females and 515 (47.6%) males were screened during the 10-day free eye screening program. The age range of the participants was 18–82 years; mean = 44.1 ± 12.15 years; 59.5% were aged 40–59 years, and 31.4% were below 40 years [Table 1]. Only 9.2% were aged 60 years and above. The participants were largely literate with 80.1% having at least tertiary education as their highest education level [Table 2].

**Table 1: Age distribution of subjects**

| Age | Number | Percentage |
|---|---|---|
| 18-39 | 340 | 31.4 |
| 40-59 | 644 | 59.5 |
| 60-79 | 97 | 9.0 |
| 80-99 | 2 | 0.2 |
| Total | 1,083 | 100 |

**Table 2: Highest education level of subjects**

| Highest Education Level | Number | Percentage |
|---|---|---|
| Primary | 76 | 7 |
| Secondary | 139 | 12.9 |
| Tertiary | 429 | 39.6 |
| Postgraduate | 439 | 40.5 |
| Total | 1,083 | 100 |

One thousand and seventy-four participants had their distance visual acuity checked. Nine participants did not cooperate for a reliable visual acuity to be taken. Nine hundred and eighty (91.2%) participants had normal vision, whereas eighty-nine (8.3%) participants and five (0.5%) participants had visual impairment and blindness, respectively [Figure 1]. On the whole, 356 participants were diagnosed with refractive error. However, 149 (41.9%) were uncorrected; 58.1% were already using spectacle correction. One hundred and nine participants (109/1,083; 10.1%) had an uncorrected refractive error in combination with presbyopia and 16 participants (16/1,083; 1.5%) had presbyopia alone. Out of the 149 participants with uncorrected refractive errors, 93 (62.4%) were astigmatic errors and 56 (37.6%) were spherical errors. The total prevalence of uncorrected refractive error in the study population was 13.8% (95% CI = 11.9–15.9); [Table 3] prevalence of astigmatism was 8.6% (95% CI = 6.9–10.3); prevalence of hypermetropia was 3.6% (95% CI = 2.5–4.7); prevalence of myopia was 1.6% (95% CI = 0.7–2.5). Hypermetropic astigmatism was the commonest astigmatic error as well as the commonest refractive error among the participants constituting 54.8% of astigmatic error and 34.2% of all errors [Table 4]. Hypermetropia was the commoner form of spherical error among the subjects constituting 69.6% of spherical errors and 26.2% of all errors [Table 4]. Although participants aged 40–59 years constituted the highest burden of uncorrected refractive errors (55% of all uncorrected errors), the errors were commonest in the 80–99 years age group, the prevalence being 12.6%, 12.7%, 23.7%, and 50% in 18–39, 40–59, 60–79, and 80–99 age groups, respectively. Hypermetropic astigmatism was the commonest refractive error in participants aged 40 years and above while myopia was the commonest refractive error in participants below 40 years of age [Table 5]. Although the overall prevalence of uncorrected refractive errors was noted to progressively increase with age, the prevalence of

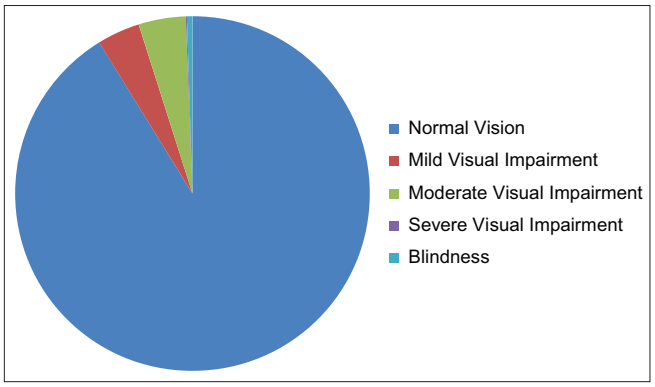


**Figure 1:** Categories of vision of subjects

myopia (including myopic astigmatism) dropped from 6.2% at 18–39 years age group to 1.7% at 40–59 years age group. Astigmatism constituted 35.8%, 44.1%, and 38.6% of the errors in 18–39 years, 40–59 years, and 60–79 years age groups, respectively [Table 5]. Hypermetropia, hypermetropic astigmatism, myopia, and myopic astigmatism were commoner in females while mixed astigmatism was commoner in males [Table 6]. The prevalence of uncorrected refractive errors in females and males were 15.1% (95% CI = 12.1–18.1) and 12.2% (95% CI = 8.8–15.4), respectively. The difference was, however, not statistically significant; $P$ = 0.26. All the uncorrected errors were commoner in the nonacademic staff than in the academic staff and this difference was found to be statistically significant; $P$ = 0.008 [Table 7]. Subjects with tertiary education as their highest level of education constituted the highest burden of uncorrected refractive errors (68%) but the prevalence was however highest in the secondary education group where uncorrected refractive errors were present in 18.7% of subjects in that category [Table 8]. There was, however, no statistically significant difference in the prevalence of uncorrected refractive errors among the four levels of education categories; $P$ = 0.714.

One hundred and twenty-five (125/1,083; 11.5%) participants had uncorrected presbyopia; prevalence of uncorrected presbyopia was 11.5% (95% CI = 9.6–13.4) in the study population.

**Table 3: Prevalence of refractive errors**

| Refractive errors | Number | Prevalence (%) |
|---|---|---|
| Uncorrected errors | 149 | 13.8 |
| Corrected errors | 207 | 19.1 |
| Emmetropia | 727 | 67.1 |
| Total | 1,083 | 100 |

**Table 4: Pattern of uncorrected refractive error**

| Refractive error | Number | % |
|---|---|---|
| Hypermetropic astigmatism | 51 | 34.2 |
| Hypermetropia | 39 | 26.2 |
| Mixed astigmatism | 23 | 15.4 |
| Myopic astigmatism | 19 | 12.8 |
| Myopia | 17 | 11.4 |
| Total | 149 | 100 |

## Discussion

The result of the eye screening showed that the prevalence of uncorrected refractive error in the study population was 13.8%. This prevalence is lower than the prevalence of 17% found in the study by Bekibele *et al.*[8] in Ibadan, Nigeria. Bekibele's subjects were, however, drivers and all males. The subjects in the present study are university staff and by virtue of their education, are likely to be more informed as regards their eye health and visual needs and are, therefore, more likely to seek correction for their refractive errors. The present prevalence, on the other hand, is higher than the prevalence of 11.6% found by Abah *et al.*[16] in Zaria, Nigeria. Abah's study was, however, a clinic-based study, and only those who presented to the clinic were studied. Again, Abah's subjects were much younger (mostly below 30 years) than the subjects in the present study. Younger adult subjects could give a lower prevalence for refractive error since it has been noted that a higher prevalence of refractive errors like hypermetropia and astigmatism is associated with increasing age in adults.[2,11] Marmamula *et al.*[17] found a prevalence of 11.8% in a rural Indian population. This is lower than the present prevalence. The subjects in the Indian study were, however, rural fishermen, who may not have the same visual needs as the subjects in the present study. The educational status of these Indian subjects could also contribute to the lower prevalence compared with the present prevalence since higher education level has been associated with a higher prevalence of refractive error.[9,10] Racial differences between the two study populations could also account for the observed differences in prevalence.

The present study also found that astigmatism was the commonest refractive error in the study population. This was followed by hypermetropia, and then myopia. Astigmatism constituted 62.4% of all refractive errors with a prevalence of 8.6%. Ezelum *et al.*[12] reported a similar pattern (astigmatism > hypermetropia > myopia) in Nigerian adults aged 40 years and above, though Ezulum's subjects were not university staff alone and were drawn from the five geopolitical zones of Nigeria. Similarly, Karoye–Egbe *et al.*[18] reported astigmatism as

**Table 5: Age distribution of uncorrected refractive error**

| Age (year) | Hypermetropic astigmatism | Hypermetropia | Mixed astigmatism | Myopic astigmatism | Myopia | Total |
|---|---|---|---|---|---|---|
| 18-39 | 3 (2.0%) | 9 (6.0%) | 10 (6.7%) | 10 (6.7%) | 11 (7.4%) | 43 (28.9%) |
| 40-59 | 40 (26.8%) | 23 (15.4%) | 8 (5.4%) | 6 (4.0%) | 5 (3.4%) | 82 (55.0%) |
| 60-79 | 8 (5.4%) | 6 (4.0%) | 5 (3.4%) | 3 (2.0%) | 1 (0.7%) | 23 (15.4%) |
| 80-99 | 0 (0.0%) | 1 (0.7%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 1 (0.7%) |
| Total | 51 (34.2%) | 39 (26.2%) | 23 (15.4%) | 19 (12.8%) | 17 (11.4%) | 149 (100%) |

$P$=0.000

the commonest refractive error in Bayelsa state, Nigeria. The subjects in their study, though eye clinic patients have a close mean age (42.18 ± 13.1 years) to that of the present study (44.1 ± 12.15 years), and this may account for the similarity in the findings. The present pattern is also similar to what Otutu *et al.*[11] found in South African adults aged 16–74 years. According to Otutu *et al.,*[11] astigmatism was the commonest refractive error with about 60% of the subjects having astigmatism. This similarity in the findings may be due to the similarity in the age range of the subjects (18–83 years in the present study). The mode age group (20–25 years) for Otutu's subjects was, however, younger than the mode age group (40–59) for the present study. The present pattern of refractive error is, however, not exactly similar to the findings of Bekibele *et al.*[8] in Ibadan. Although Bekibele *et al.*[8] found hypermetropia as the commoner spherical error as in the present study, it was also the commonest refractive error in contrast to present finding where astigmatism was the commonest error. Bekibele's subjects were, however, all males, unlike the study by Anajekwu *et al.*[19] among teachers in Onitsha, Nigeria, where though the commonest refractive error found was hypermetropia, most of the teachers (81.5%) were females. Some studies have found hypermetropia to be commoner in females.[10,11] However, Ezepue's finding in Enugu[20] and Bagiya *et al.*'s[21] finding in Kaduna also noted hypermetropia as the commonest refractive error. The subjects in both studies, however, included adults and children, unlike the present study that involved only adult subjects.

There was a progressive increase in the prevalence of uncorrected refractive error with age in the present study. This is similar to an earlier finding in Caucasians and African Americans where the prevalence of myopia and hypermetropia was found to increase steadily with age.[2] Abdullah *et al.*[22] noted a similar pattern in Pakistan where they found that uncorrected refractive errors increased with age in adults aged 30 years and above. Abdullah's subjects were, however, rural dwellers, unlike our subjects who were from a university community. It is likely that the prevalence of refractive errors with age shows a similar pattern for both rural and urban dwellers. The steady increase in the prevalence of refractive error with increasing age is also similar to Otutu *et al.*'s[11] observation in South Africa that myopia up to the age of 45 and hypermetropia increases with age. Ezelum *et al.*[12] in Nigeria, similarly found that myopia and astigmatism increase with age in adults aged 40 years and above. The prevalence of myopia in the present study was also found to decrease after the age of 40 similar to Otutu's[11] finding in South Africa. Abah *et al.*,[16] however, did not find any statistically significant difference in the age distribution of refractive errors in a Nigerian university community. Abah's subjects were, however, younger (most aged 21–30 years) than subjects in the present study, and this may account for the observed differences.

The present study found no statistically significant difference in the prevalence of uncorrected refractive errors between male and female subjects though the prevalence was higher in females. This is similar to the finding of Malu *et al.*[23] in Jos, even though their subjects included children as young as 5 years. They noted

**Table 6: Sex distribution of uncorrected refractive error**

| Refractive error | Male | Female | Total |
|---|---|---|---|
| Hypermetropic astigmatism | 25 (48.9%) | 26 (51.1%) | 51 |
| Hypermetropia | 12 (30.8%) | 27 (69.2) | 39 |
| Mixed astigmatism | 14 (60.9%) | 9 (39.1) | 23 |
| Myopic astigmatism | 7 (36.8%) | 12 (63.2) | 19 |
| Myopia | 5 (29.4%) | 12 (70.6%) | 17 |
| Total | 63 | 86 | 149 |

*P*=0.26

**Table 7: Distribution of uncorrected refractive error based on employment status (academic and nonacademic staff)**

| Refractive error | Academic | Nonacademic | Total |
|---|---|---|---|
| Hypermetropic astigmatism | 17 | 34 | 51 |
| Hypermetropia | 11 | 28 | 39 |
| Mixed astigmatism | 7 | 16 | 23 |
| Myopic astigmatism | 3 | 16 | 19 |
| Myopic | 0 | 17 | 17 |
| Total | 38 (25.5%) | 111 (74.5%) | 149 (100%) |

*P*=0.008

**Table 8: Distribution of uncorrected refractive errors based on level of education**

| Level of education | Hyper metropic astigmatism | Hyper metropia | Mixed astig matism | Myopic astig Matism | Myopia | Total |
|---|---|---|---|---|---|---|
| Primary | 4 | 5 | 1 | 0 | 0 | 10 (6.7%) |
| Secondary | 10 | 4 | 3 | 3 | 6 | 26 (17.5%) |
| Tertiary | 16 | 18 | 12 | 12 | 10 | 68 (45.6%) |
| Postgraduate | 21 | 12 | 7 | 4 | 1 | 45 (30.2%) |
| Total | 51 | 39 | 23 | 19 | 17 | 149 (100%) |

*P*=0.714

that though males had more myopia and astigmatism, and females had more hypermetropia, there was no statistically significant difference between the sexes.[23] Abah *et al.*[16] similarly found no statistically significant difference in the prevalence of refractive errors between males and females. Abah's[16] subjects were also younger than subjects in the present study. On the contrary Lawan *et al.*[10] in Kano, found that refractive errors were more prevalent in females than in males and that the difference was statistically significant. Lawan's[10] subjects were however only presbyopic patients aged 35 years and above and were eye clinic patients, unlike the present study. This could account for the observed difference.

All the uncorrected refractive errors were commoner in the nonacademic staff than in the academic staff. It is probable that because of the nature and the visual demands of their job, the academic staff is more likely to seek eye care compared with the nonacademic staff. It could also be that the academic staff subjects are more aware of the need for eye care compared with the nonacademic staff subjects. This is likely because the prevalence of uncorrected refractive errors in our study was highest in subjects with secondary education as their highest level of education. This finding is similar to what Wong *et al.*[24] found in Chinese adults. They noted that less than 13 years of education was associated with a higher prevalence of uncorrected refractive error.[24] Similarly, Ho *et al.*[25] in their study in Singapore teenagers, found that uncorrected refractive errors were commoner in technical students than in regular students.

## Conclusion

A significant proportion of the university staff in the University of Nigeria Nsukka, Nigeria still have an uncorrected refractive error with the attendant visual impairment and decreased quality of life. Despite being an enlightened community, more than two-fifths of those with a refractive error are still living with it uncorrected.

To achieve VISION 2020: The Right to Sight, primary eye care needs to be incorporated into primary healthcare services with an eye care provider situated in the university's healthcare center.

### Recommendations

Engagement of an Optometrist in the University of Nigeria, Nsukka's Medical Center to improve access to eye care, especially refraction services.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

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