

## **Presbyopia and Vision-related Quality of Life in Calabar South, Nigeria**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Author ENE designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AO and RED managed the analyses of the study. Author ENE managed the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

**Aim:** To determine the magnitude of presbyopia and the effect of uncorrected presbyopia on vision-related quality of life in Calabar South, Nigeria.

**Study Design:** A community-based, descriptive cross-sectional study.

**Place and Duration of Study:** Calabar South Local Government Area, Nigeria, between November 2016 and February 2017.

**Methods:** We included 422 adults (198 men, 224 women) aged 35 years and above, selected by cluster random sampling. Subjective distance refraction was done on all participants with distant visual acuity less than 6/6. Near visual acuity was assessed at 40 centimetres with a Times Roman near vision (British N system) chart, with distant correction in place if required. Presbyopia was defined as inability to read N8 at 40 centimetres unaided or with habitually worn distance refractive correction, with improvement of near vision by at least one line on a Times Roman near

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vision chart with use of a plus lens. An adapted and validated quality of life questionnaires were administered to the participants.

**Results:** A total of 422 participants were examined and interviewed. The prevalence of presbyopia was 55.5%. There was no significant association between gender and prevalence of presbyopia. The presbyopia correction coverage in the study population was 38.0% with a strong positive correlation between age and the required near vision spectacle lens power ( $r = 0.88, p < .001$ ). Another key finding was a significant association between uncorrected presbyopia and reduced quality of life.

**Conclusion:** This study has demonstrated that the burden of presbyopia in the study population is enormous in spite of the fact that it has a cost effective intervention. The key findings in this study underscore the need to scale up presbyopic correction services in the study area.

*Keywords: Presbyopia; quality of life; Calabar South; Nigeria.*

## 1. INTRODUCTION

Presbyopia refers to an age-related loss of accommodation of the crystalline lens that results in an inability to focus at near distances. It is the most common physiological change occurring in the adult eye and is believed to cause universal near vision impairment with advancing age [1]. The amplitude of accommodation decreases with age and symptoms may manifest about the age of 40 years. Symptoms may, however, start earlier or later than this age depending on the refractive state of the patient's eyes, their visual needs and depth of focus among other variables such as residence in the tropics [2]. Variables associated with either earlier onset or increased severity of presbyopia include: female sex, increasing age, higher educational background and urban residence [3].

About 1.1 billion people have been estimated to have near vision impairment simply because they do not have a pair of spectacles [4]. This global prevalence of presbyopia is predicted to increase to 1.4 billion by 2020 and to 1.8 billion by 2050 [5]. The prevalence of presbyopia in low- and middle-income countries is not well known, as most studies of refractive error in these countries have been limited to distance vision [1]. There are few studies on presbyopia that have used a population-based approach, making it difficult to draw conclusions about the prevalence of presbyopia in the general population [1]. However, a prevalence as high as 85.4% have been reported [6]. Another major challenge with research in this area is the absence of a universally accepted definition for presbyopia and no standardized technique of measurement. The prevalence of presbyopia will therefore depend on how it is defined, for instance, the end point chosen and the distance at which near vision is tested [1].

Presbyopia affects quality of life both in high-income countries, where reading and writing are the main near vision tasks undertaken, [7] and in populations where reading and writing are less a part of daily life for example in the rural populations of low- and middle-income countries [8]. Uncorrected presbyopia can have a potential negative impact on career choice, ocular health and self-esteem and can therefore hamper development [7].

As low - and middle-income countries undergo the demographic transition towards an ageing population, the number of people with presbyopia will increase. The demand for near vision and near vision correction is also increasing with the widespread use of devices such as mobile phones and computers, even in rural areas of the developing world [5]. Presbyopia is associated with worse vision targeted health-related quality of life compared with young patients with ametropia (refractive error) [7].

Few population-based surveys have been conducted to assess the burden of presbyopia in developing countries and even fewer studies on impact of presbyopia on quality of life in developing countries [9]. This is attributed to the perception that presbyopia is not important in areas with low literacy rates such as low- and middle-income countries [9]. This perception lacks evidence as only few population-based studies have assessed presbyopia in the developing world and anecdotal evidence reveals the need for good near vision even among rural dwellers who require it for near vision-related tasks such as threading needles, sorting rice and cutting nails [8]. Service provision for presbyopia begins with estimating the need. This study among other things estimated this (presbyopic service) need in the target population.

With the emphasis on adult education and literacy as well as good quality of life, it becomes necessary to estimate the level of presbyopia in the population with a view to developing refraction and optical services that have a high success rate vis-a-vis visual acuity (distance and near) and improved quality of life. The aim of this study, therefore, was to determine the magnitude of presbyopia and the effect of uncorrected presbyopia on vision-related quality of life in Calabar South Local Government Area of Cross River State, Nigeria with a view to generating data that could be useful in the planning and implementation of successful comprehensive presbyopic correction service in Calabar South, Nigeria.

## 2. MATERIALS AND METHODS

### 2.1 Study Design and Setting

This descriptive cross-sectional research was conducted among adult residents of Calabar South Local Government Area of Cross River State, Nigeria from 1<sup>st</sup> November 2016 to 28<sup>th</sup> February 2017. Calabar South Local Government Area is found in the southern senatorial district of Cross River State. Its headquarters is in the town of Anantigha. It has an area of 264 km<sup>2</sup>, a density of 725.4 inhabitants/km<sup>2</sup> and a population of 191,515 at the 2006 Nigerian National census [10]. It is divided into 12 political wards and has a general hospital, 28 primary health centres/health posts spread across the 12 political (electoral) wards, numerous private health facilities and optical shops (eye care facilities that are run by optometrists or refractionist). The general hospital in Calabar South is a government owned secondary health facility with an eye unit that is run by the Cross River State Eye Care Programme. The eye unit provides comprehensive eye care services, including refractive error and presbyopic correction services. About 5 kilometres away from the local government headquarters is the University of Calabar Teaching Hospital in Calabar Municipality with an ophthalmology department that provides comprehensive tertiary eye care services, refractive error and presbyopic correction services inclusive.

### 2.2 Sample Size Determination

Allowing for 10% attrition, a minimum sample size of 420 participants was calculated using the formula for single proportion: [11,12]

$$n = z^2 pq/d^2$$

Where;

$n$  = minimum sample size (when population is >10,000)

$z$  = Standard error of the mean which corresponds to 95% confidence level (1.96)

$p$  = Proportion of the target population estimated to have the particular characteristic, in this case presbyopia. The prevalence of 53.4% was used in the study [13].

$q$  = 1- $p$

$d$  = Precision with which  $p$  is determined which is 5% (0.05)

### 2.3 Study Population

The study population was a randomly selected sample of political (electoral) wards in Calabar South Local Government Area that was obtained from the 2006 census data.

### 2.4 Selection Criteria

The eligibility criteria were based on criteria used in previous studies on presbyopia [14,15].

#### 2.4.1 Inclusion criteria

Individuals aged 35 years and above who had resided in the selected area for a minimum of 6 months were recruited for the study. Another inclusion criterion was presenting visual acuity of 6/60 or better in at least one eye. Participants also had pinhole visual acuity improvement of 6/18 or better in at least one eye.

#### 2.4.2 Exclusion criteria

Individuals with mental or other incapacitating illnesses whose vision could not be tested were excluded from the study. Refusal to give informed consent was another exclusion criterion that was utilised.

All subjects that were excluded on account of visual impairment were examined by the first author and referred to the eye clinic of the University of Calabar Teaching Hospital, where necessary. Minor ocular conditions like allergic conjunctivitis and suspected mild dry eye disease were treated in the field.

### 2.5 Sampling Technique

Cluster sampling with equal allocation was used to select a representative sample of the

population. The survey was carried out in 7 out of the 12 political wards (which served as clusters) in Calabar South using a simple random sampling technique. All eligible participants in sampled clusters who consented to participate in the research were enrolled into the study until the desired sample size was attained.

## 2.6 Survey Tool

The survey questionnaire was adapted from an interviewer administered semi-structured questionnaire that was validated in the International Centre for Eye Health of the London School of Hygiene and Tropical Medicine and had been used in Nigeria in an earlier study [13]. It comprised four sections: information was collected on basic socio-demographic characteristics; distance/near visual acuity assessment with subjective refraction and service provision; visual function and quality of life.

## 2.7 Data Collection Procedure

### 2.7.1 Examination of participants

Participants were examined and interviewed in their homes. Presenting distance visual acuity was tested in all subjects by an ophthalmic nurse in the team with a tumbling E Snellen chart at 6 meters in ambient outdoor illumination under a shade. Correct identification of more than half of the optotypes in a line constituted success at reading that line. Distance subjective refraction was then performed by the first author (an ophthalmologist) in subjects with visual acuity  $\geq 6/60$  but less than 6/6 if improvement of visual acuity to at least 6/18 (in one or both eyes) is demonstrated with a pinhole test. The refraction was conducted with a trial lens set with addition of plus or minus lenses in 0.5 dioptre increments until the subject reads 6/6 or has no further improvement in visual acuity. Astigmatism was not corrected to reduce testing time due to time constraints in data collection.

Near vision was then tested by the ophthalmologist (first author) with a Times Roman near vision (British N system) chart at a distance of 40 cm under ambient illumination. The distance of 40 cm from the eyes was maintained with an inextensible string which was attached to the top of the chart at one end, while the other end was placed against the subject's forehead and held taut. A subject was defined as presbyopic (functional presbyopia) if s/he cannot

read the N8 optotype (Times Roman Printer's Point) at 40 cm unaided or with habitually worn distance refractive correction, with improvement of near vision by at least one line on a Times Roman near vision (British N system) chart with use of a plus lens. The N8 optotype was selected as it matches the type size for newsprint in Nigeria. This definition of presbyopia is the near equivalent of distance visual impairment (i.e.  $<6/18$ ) which translates to N-sized (typeface size) print at 40cm with a Times Roman near vision chart, requiring at least +1.00 dioptre (D) near add to see clearly [16].

Near visual acuity (VA) was tested binocularly and recorded as the smallest line with over half of the optotypes read, spelled or reported as seen correctly. The distance correction was put in place for those that require it before near vision testing was done. Subjects with uncorrected near VA  $< N8$  on N notation chart underwent vision testing with progressively higher plus sphere power (in increments of + 0.5 dioptre and + 0.25 dioptre occasionally) in both eyes simultaneously until a binocular vision of at least N8 was obtained or no further improvement occurs. Subjects that present with a VA of 6/6 were assumed to be emmetropic and were tested for near vision as described without undergoing distance refraction. The spherical dioptre corrections along with the corresponding best-corrected near visual acuity were recorded. Subjects that needed presbyopic glasses were provided with a pair of near vision spectacle free of charge while patients with reduced visual acuity that did not improve with refraction and those that needed distance correction were referred to the eye clinic of the University of Calabar Teaching Hospital, Calabar.

The anterior and posterior segments of the eye were examined in detail.

### 2.7.2 Interview of participants

The interview questions included: socio-demographic characteristics, visual function and questions on quality of life. Visual functions that were covered in the interview included reading, writing, use of mobile phones, cooking food, sorting out rice/grain, threading a needle, cutting finger nails etc. Participants were asked if they regularly conducted the particular activity. If the answer was 'yes', they were then asked to rate the difficulty they have performing such activity due to poor near vision base on a rating scale of 1-5 where: 1 = no difficulty, 2 = little difficulty, 3 =

moderate difficulty, 4 = great difficulty, 5 = do not undertake the task (not applicable). Participants were instructed that this is a linear increase in severity and other factors that did not relate to their near vision (e.g. mobility and distance) were not relevant to this question.

Regarding near vision-related quality of life, the participants were asked how much satisfaction they have with their distance vision, near vision and general health. They then rated their level of satisfaction as: 1 = very satisfied, 2 = satisfied, 3 = do not know, 4 = dissatisfied, 5 = very dissatisfied. These ratings correspond to 100%, 75%, 50%, 25% and 0% respectively.

Further questions on quality of life assessment included how much difficulty the participant has in carrying out his or her daily tasks and how much near vision contributed to the difficulty among others. All collected data were entered into a study questionnaire for each participant.

## 2.8 Data Management and Analysis

Each completed questionnaire was checked at the end of each day to ensure that there was no missing information. Data was double entered and validated in Microsoft Office Excel 2007 for Windows XP Professional and was later uploaded and analysed using the Statistical Package for the Social Sciences version 21 (SPSS, Chicago IL). Point prevalence estimates were calculated. Descriptive statistics (frequencies and proportions) were used to summarize qualitative variables. Chi-square test was used to test for association between categorical variables.

Presbyopic correction coverage (PCC) was calculated with the formula:

$$\text{PCC (\%)} = 100 \times \frac{\text{Met need}}{\text{Met need} + \text{Unmet need}}$$

Level of statistical significance was set at *P* value of less than 5% (.05).

## 3. RESULTS

A total of 422 participants were recruited to participate in the study. There were more females than males in the study sample (224/422, 53.1%). The mean age of participants was 51 years ( $\pm 11.2$ ) ranging from 35 to 82 years. Almost three out of every five (59.2%) members of the study population were in the 35

to 50 years age group, while participants aged 67 years and above constituted the least age group (11.4%) [Table 1]. About two-fifth of the study population (40.5%) had tertiary education while at least 9 out of every 10 persons examined belong to the most popular religion in southern Nigeria: Christianity. About two out every five person surveyed (41.0%) was self-employed (Table 1).

### 3.1 Prevalence of Presbyopia in Calabar South

Two hundred and thirty-four out of 422 of the study participants were presbyopic. This gives a prevalence of  $234/422 = 0.555$  or 55.5% (95% confidence interval 51.3 – 60.1) ( $p < .001$ ) in the study population (Fig. 1).

### 3.2 Prevalence of Presbyopia among Respondents by Sex

Chi-square test for assessing relationships between categorical variables indicated no significant association between gender and prevalence of presbyopia among the study participants. However, more female participants 132 (58.9%) compared to males 102 (51.5%) had presbyopia (Table 2).

### 3.3 Presbyopia Correction Coverage

Met presbyopic need (number of presbyopic participants who already had near vision spectacles during the study period) = 89

Unmet presbyopic need (number of presbyopic subjects who did not own near vision spectacles during the study period) = 145

$$\begin{aligned} \text{Spectacle coverage (\%)} &= \frac{\text{Met need}}{\text{Met need} + \text{unmet need}} \times 100 \\ &= \frac{89}{89 + 145} \times 100 \\ &= 38.0\% \end{aligned}$$

The calculation above reveals that the presbyopia correction coverage in the study population during the study period was 38.0%.

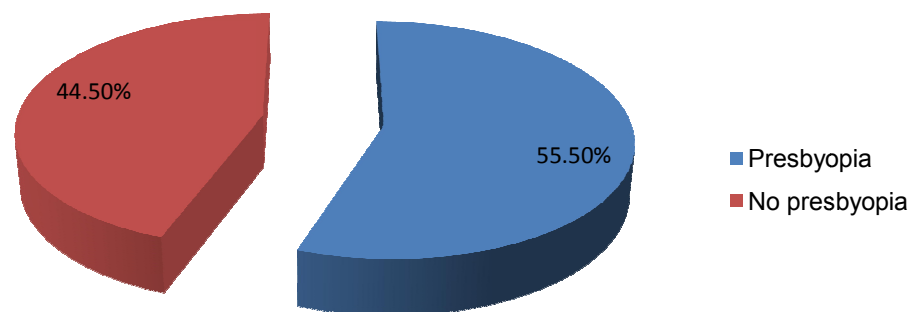
### 3.4 Age and Presbyopia

There was a strong positive correlation between age and the required near vision spectacle lens power ( $r = 0.88$ ,  $p < .001$ ) with increasing age associated with higher presbyopic correction lens power (Fig. 2).

**Table 1. Socio-demographic characteristics of study participants (N = 422)**

Variable	Frequency (N = 422)	Percentage (100.0%)
<b>Age group (years)</b>		
35-50	250	59.2
51-66	124	29.4
67-82	48	11.4
<b>Sex</b>		
Male	198	46.9
Female	224	53.1
<b>Religion</b>		
Christianity	396	93.8
Islam	20	4.7
Others*	6	1.4
<b>Educational status</b>		
Non-formal	54	12.8
Primary	41	9.7
Secondary	156	37.0
Tertiary	171	40.5
<b>Occupation</b>		
Unemployed	35	8.3
Self-employed	173	41.0
Civil servant	154	36.5
Retired	48	11.4
Others**	12	2.8
<b>Tribe</b>		
Efik	124	29.4
Ibibio	54	12.8
Ekoi	72	17.1
Others***	172	40.8

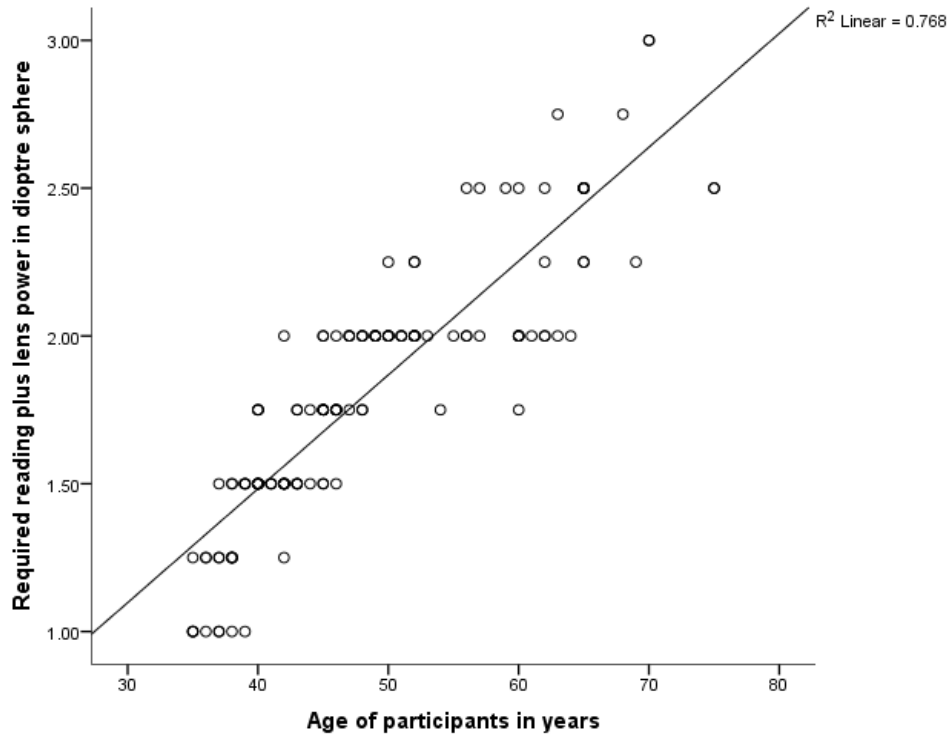
*Others\* include Grail Message, Eckankar, Rosicrucian and None. Others\*\* include politician and student  
Others\*\*\* Igbo, Anang, Efut, Idoma, Oron, Degema, Quas, Ejagham, Bette, Bekwarra, Boki, Ukelle, Tiv, Andoni,  
Yoruba, Urobo, Igbira, Nkim, Bansara, Ijaw, Abuo, Igalla, Mbembe,  
Olulumo, Yakurr, Hausa, Isoko and Nupe*

**Fig. 1. Prevalence of presbyopia in the study participants (N = 422)**

**Table 2. Prevalence of presbyopia among respondents by sex**

Variable	Sex		$\chi^2$	P- value
	Male (n=198) Freq. (%)	Female (n=224) Freq. (%)		
<b>Presbyopia</b>				
Present	102 (51.5)	132 (58.9)	$\chi^2 = 2.05, df = 1$	.15*
Absent	96 (48.5)	92 (41.1)		
Total	198 (100)	224 (100)		

\*P > .05 Freq. = Frequency



**Fig. 2. Relationship between age and presbyopic correction lens power**  
*r = 0.88, n = 145, P < .001*

**3.5 Association between Presbyopia and Near Vision-related Quality of Life**

A significantly higher proportion of the respondents with uncorrected near vision had low level of satisfaction with their vision-related

quality of life compared to participants with corrected presbyopia (Table 3). Further test of association revealed that presbyopes are more likely to require help from other people as a result of poor near vision than do non-presbyopes (Table 4).

**Table 3. Association between level of satisfaction with near vision and presbyopia among respondents (n = 234)**

Presbyopes (n = 234)	Near vision-related QOL			$\chi^2$	P-value
	Satisfied freq. (%)	Dissatisfied freq. (%)	Don't know freq. (%)		
Corrected (n = 89)	33 (36.6)	53 (59.2)	3 (3.8)	11.77	.008*
Uncorrected(n = 145)	33 (23.1)	108 (74.5)	4 (2.4)		
Total	66 (28.2)	161 (68.8)	7 (3.0)		

\*P < .05; Freq. = Frequency

**Table 4. Comparison of the frequency of requiring support/assistance due to poor near vision in presbyopes and non-presbyopes**

Variable	Assistance needed due to poor near vision		$\chi^2$	P- value
	Yes freq. (%)	No freq. (%)		
Presbyopes (n = 234)	180 (76.9)	54 (23.1%)	28.54	.001*
Non-presbyopes(n=188)	97 (51.6%)	91 (48.4%)	df = 1	
Total (N = 422)	277	145		

\*P &lt; .001 Freq. = Frequency

#### 4. DISCUSSION

The effect of presbyopia on quality of life and society in both the developed and developing worlds is a public health issue [17]. This survey provides a population-based data on the prevalence of presbyopia and the public health impact of uncorrected presbyopia vis-à-vis its effect on quality of life in residents of Calabar South, Nigeria.

##### 4.1 Prevalence of Presbyopia in Calabar South

The prevalence of presbyopia in this study was 55.5%. An earlier study in adults aged 35 years and older in Nike, Enugu State, Nigeria found an objective presbyopia prevalence of 63.4% [14]. A study in Gwagwalada, Nigeria found a functional presbyopic prevalence of 53.4% [15] which is similar to the finding in this study. A similar study which examined 650 individuals aged 40 years and above in Bungudu Local Government Area of Zamfara state in north-west Nigeria, found a presbyopic prevalence of 30.4%. Other previous studies found presbyopic prevalence of 85.4% in the Rift valley of Kenya,[6] and 61.7% in rural Tanzania [9]. An earlier study in Chinese adults aged 40 years and above found a prevalence of 69.3% [18]. The varying differences in prevalence of presbyopia may be due to the different definitions of presbyopia, different minimum age of study participants and different examination conditions (outdoors or indoors). Age as confirmed by the current study (Fig. 2) is an established risk factor for development of presbyopia [19]. Furthermore, some studies examined for objective presbyopia [14] while others examined for functional presbyopia [15,20]. The current study examined for functional presbyopia. When functional presbyopia is used, people with low or moderate myopia are less likely to be identified as requiring presbyopic correction, so the estimated prevalence will be lower.

Another important finding of the present study was that the observed difference in prevalence of

presbyopia between male (51.5%) and female (58.9%) participants was not statistically significant (Table 2). Although, these results differ from some published studies,[9,19,15,20] they are consistent with those of a study in Jos, Plateau state, Nigeria [21].

The spectacle coverage of 38.0% in the current study is higher than presbyopia correction coverage obtained in a previous study conducted in a rural community in Enugu, south-east of Nigeria which found presbyopic spectacle coverage of 27.8% [14]. Another study in a rural community in Abuja found a presbyopia correction coverage of 21%, [22] whereas a similar study in a rural population in Zamfara state, north-western Nigeria revealed a presbyopia correction coverage of only 0.7% [20]. A possible explanation for this discrepancy is that unlike the current study, the previous studies cited were all conducted in rural communities where it may be unlikely to find any form of eye care services. Literacy level and requirement for use of reading spectacles are also more likely to be higher in urban community than rural settlements.

The strong positive correlation between age and required near vision spectacle lens power observed in the current study is consistent with a previous work which linked increased severity of presbyopia to age and higher educational background [3]. A significant proportion of the participants (40.5%) in the present study had tertiary education.

##### 4.2 Effect of Uncorrected Presbyopia on Vision-related Quality of Life

The current study found significant association between uncorrected near vision and reduced vision-related quality of life among the study participants (Table 3). A higher proportion of presbyopic participants were found to require help from other people as a result of difficulty with near vision than do non-presbyopes (Table 4). The findings observed in this study mirror



those of a previous study that have examined the impact of uncorrected presbyopia on vision-related quality of life in a rural African setting.[8] The findings also corroborate the results of previous studies in Nigeria which found an association between uncorrected presbyopia and vision-related quality of life [23,24]. This combination of findings provides some support for the conceptual premise that uncorrected presbyopia has potential negative impact on quality of life and self-esteem.

### 4.3 Limitations of the Study

An arguable weakness is the use of the WHO recommendations for the definition of presbyopia: inability to read N8 at 40 cm. This definition does not consider the fact that some persons may still require spectacles for reading prints tinier than N8 optotype. Finally, the issuance of free reading spectacles to participants that needed it during the study was likely to influence their responses to some of the interview questions. Information bias that likely resulted from this was however reduced to the barest minimum by concealing the fact that free spectacles will be issued until after the survey was completed in a household.

## 5. CONCLUSION

This study has shown that presbyopia with a prevalence as high as 55.5% but with a presbyopia correction coverage of only 38.0% in the study population is a major eye health issue that requires intervention. Another obvious finding to emerge from this study is the significant negative impact of presbyopia on vision-related quality of life. To address these issues, there is need to scale up presbyopic correction services in the study area.

## CONSENT

As per international standard written informed participant consent has been collected and preserved by the authors.

## ETHICAL APPROVAL

Ethical clearance was obtained from the Cross River State Health Research Ethics Committee. Permission to conduct the study in the LGA was obtained from the LGA primary health care coordinator, the village chiefs and the Director of Cross River State Eye Care programme.

## COMPETING INTERESTS

All authors have declared that no conflict of interests or financial support exist.

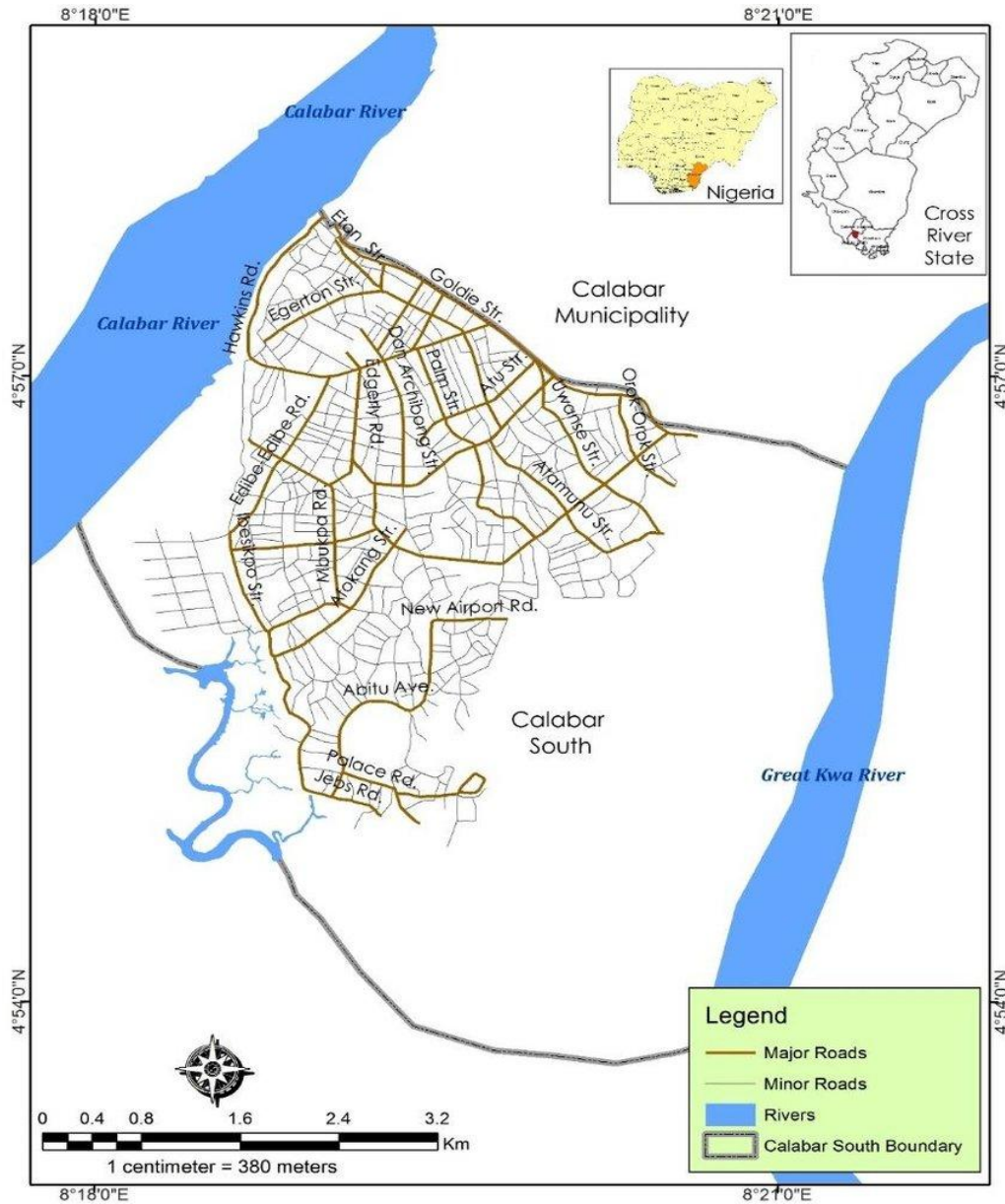
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## APPENDIX

### Map of Calabar South



Source: [https://www.researchgate.net/figure/Map-of-Calabar-South-LGA\\_fig1\\_328996399](https://www.researchgate.net/figure/Map-of-Calabar-South-LGA_fig1_328996399)

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