

# Presbyopia: Prevalence, distribution and determinants in Owerri, Nigeria

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## Abstract

**Background:** Presbyopia causes blurring and impairment of vision at near. It is the most common physiologic change in the adult eye with advancing age. Good near vision is a necessity for domestic activities, office work and near vision tasks other than reading and writing, especially among adults in a resource-limited economy. The study determined the prevalence, distribution and determinants of presbyopia; presbyopic spectacle coverage; and provided data for ready-made near vision spectacles in Imo State, Nigeria. **Materials and Methods:** A total of three thousand, four hundred and fifty-one adults consisting of 2606 persons as study group and 845 persons as controls were randomly selected for the study. Structured questionnaire was administered to the subjects. Their visual acuity at far and near including tonometry, ophthalmoscopy, perimetry, retinoscopy and subjective refraction were done. Subjects who could not read N6 and emmetropes, who are 40 years and above were considered as presbyopic. **Results:** The prevalence of presbyopia was 70.9% and 75.0% of study and control groups respectively. Females aged 40-49 were in the majority (57.1% and 51.9% of females in the study and control groups respectively). Subjects requiring additions at near of >+1.50DS to 2.00DS were in the majority (39.0% and 46.4% of study and control groups respectively). Amongst the presbyopes 61.3% and 78.7% of study and control groups respectively did not have presbyopic correction. The subjects were also ignorant of corneal inlay technology in treatment of presbyopia. A higher prevalence exists among rural dwellers and the contributory factors were environmental influences, poor nutrition and irrational use of chloroquine for treatment of malaria. **Conclusion:** Over seventy-percent of presbyopia was found in this study. The determinants were age, gender, nutrition and drug use. Majority of the presbyopes were domicile in the rural area and did not have corrective spectacles. We recommend visual health education, regular vision screening and intervention to achieve the targets of vision 2020 in low-and-medium-income countries.

**Key words:** Ametropia, determinants, presbyopia, prevalence, visual impairment

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## INTRODUCTION

Presbyopia is an age-related progressive loss of crystalline lens power of accommodation resulting in the inability to focus at near distances. It causes near vision impairment with advancing age (Holden *et al.*, 2008; Patel and West, 2007; Weale, 2003). The ability of the eye to focus or form clear images of both far and near objects on the retina is called accommodation (Borish, 1975; Emerole *et al.*, 2011). The human lens (crystalline lens) makes the fine adjustments which bring the image into sharp focus on the retina. This is done by a change in the thickness of the lens. When focusing on a distant object, the lens becomes thinner

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and when focusing on a near object, the lens bulges or becomes fatter (more convex). These changes in the shape of the lens are brought about by the ciliary muscles (Borish, 1975; Emerole *et al.*, 2011). Anomalies of accommodation include: Excessive accommodation; Insufficiency of accommodation; Ill-sustained accommodation; Inertia of accommodation; Unequal accommodation; Absence of accommodation or undeveloped accommodation (Borish, 1975; Emerole *et al.*, 2011; Patel and West; 2007). Presbyopia is not a refractive error (ametropia), but is now increasingly recognized as an aspect of refractive error that needs to be addressed. Good near vision is important even among populations who use it for tasks other than reading and working. Presbyopia poses an important public health challenge, because it affects older people's ability to maintain their economic independence (Patel and West; 2007). This is more evident in high-income countries where reading and writing is the main near vision task. There are also near vision tasks other than reading and writing that are predominant in rural communities that require good near vision (Emerole *et al.*, 2011; Patel and West; 2007).

The age at onset of presbyopia is usually between 38 and 45 years, and the prevalence is 100% by age 55 (Borish, 1975). Patients with presbyopia are usually at high risk of age-related diseases (Holden, 2007). Early onset of presbyopia is associated with hyperopia (Borish, 1975; Holden, 2007). In addition to the 153 million persons with vision loss due to uncorrected ametropia at far, there are hundreds of millions who have severe near vision impairment [near vision equivalent <6/18 in the eye with better vision] due to uncorrected presbyopia. It has been estimated that 1.04 billion people in 2005 were presbyopic, 517 million of who were without adequate spectacle correction. Papers published on uncorrected ametropia in Africa and Asia show that in some countries up to 94.0% of people with presbyopia have no correction at all (Borish, 1975; Emerole *et al.*, 2011; Holden, 2007; Holden *et al.*, 2008; Patel and West, 2007). In the presbyope, the automatic focusing power of the eye is diminished and gradually lost (Borish, 1975). It is reported that the amplitude of accommodation decreased more rapidly in women than in men; and in Negroes than in whites. Tall, long-armed individuals whose accustomed near working distance is farther than that of shorter persons may be expected to suffer inconveniences of presbyopia at a later date. Likewise, individuals in pronounced sedentary occupations involving detailed close work may be expected to note onset of presbyopia sooner than later (Duarte *et al.*, 2003; Wong *et al.*, 2001).

The major complaint in presbyopia is blurring of vision at near, especially in reduced illumination. The presbyope makes excessive effort to see and read at the customary near working distance and this result in eye strain and headache (Holden, 2007; Weale, 2003). Since presbyopia

is as a result of the change in the crystalline lens with age, it cannot be said to be cured, but presbyopic persons can compensate for it by reading at near or doing near distance work with single vision convex lenses, bifocals, progressive addition lenses or corneal inlays. Trifocals may be of advantage to a surgeon that operates at intermediate distance. Presbyopia is not a disease. No exercise or medication can reverse presbyopia. There is a need to change the eyeglass prescription from time to time between the ages of 40 and 60, because the lens continues to lose flexibility with advancing age (Borish, 1975; Emerole *et al.*, 2011; Kumah *et al.*, 2011; Weale, 2003). The prevalence of presbyopia in low- and -medium-income countries is not well known as most studies of refractive error in these countries have been limited to distance vision (Bekibebe *et al.*, 2011; Emerole *et al.*, 2011). There is also little known about the prevalence, distribution and determinants of presbyopia in the adult population of Nigeria (Nigerian Optometric Association, 2007). The present study was aimed at determining the prevalence, distribution and determinants of presbyopia in Owerri, Imo State, Nigeria in order to create a data-baseline for intervention.

## MATERIALS AND METHODS

A total of three thousand, four hundred and fifty one [3,451] subjects (made up of 2606 adults aged 20-69 in study group) between September 2007 and November 2009 were recruited from autonomous communities in Owerri. The controls (845) from Owerri-West Local Government Area of Imo State, Nigeria were selected after a multi-stage random sampling technique. The controls were subjects who did not present with any eye defects. Interviewer-administered structured questionnaires were used to determine demographic characteristics, dietary habits, alcohol consumption, tobacco use, spectacle use, past ocular and systemic history of subjects. Those with conditions interfering with accurate ocular refraction such as corneal opacity, visually impairing ocular media, diabetes mellitus, hypertension, pseudophakics and aphakics were excluded from the analysis.

All the subjects underwent a complete ophthalmic examination which included measurement of distant, near and pinhole visual acuity in subjects with visual acuity less than 6/6 (with snellen's chart and near reading charts); tonometry (tonometric values of 9-24 mmHg were taken as normal while tonometric values >24 mmHg were considered clinically significant); ophthalmoscopy (internal eye examination was done with a direct ophthalmoscope); retinoscopy (refractive status was determined objectively with the streak retinoscope, trial frame and trial lenses); subjective refraction and perimetry to investigate other possible causes of impairment or reduction in vision.

Subjects were also tested for near vision with reading glasses, if they owned them and had them present at the time of the examination. Ocular measurements were conducted on the study and control groups with the same protocol. Refractive errors (ametropia) and presbyopia were defined. Subjects who could not read N<sub>6</sub> and emmetropes (spherical dioptric power between -0.50 DS and +0.50 DS) who are 40 years and above were considered as presbyopic. Result analysis was done with EPI INFO [Epi Info is a public domain statistical software for epidemiology developed by Centers for Disease Control (CDC) and Prevention in Atlanta, Georgia, United States of America] version 3.5, 2008 statistical data package. Ethical approval for the study was obtained from Ethical Committee of College of Medicine and Health Sciences, Abia State University, Uturu; and consent was obtained from the subjects.

## RESULTS

### Prevalence of Presbyopia in Subjects

Majority of the subjects in this study (70.9% and 75.0% of study and control groups respectively) had presbyopia. There was no statistically significant difference between study and control groups as shown in Table 1.

### Demographic Characteristics of Subjects

Females aged 40–49 (41.8% and 57.4% of the study and control groups respectively) were in the majority. There was no statistically significant difference in prevalence of presbyopia in male and female subjects as shown in Table 2. In this study, about 61% of subjects in both study and control groups had location of residence in a rural area; 41.8% and 30.8% of study and control groups respectively had tertiary education; students (22.9%) were in the majority in the study group while skilled persons (21.5%) were in the majority in the control group.

Table 1: Prevalence of presbyopia in subjects

Eye condition	Study group n=2606		Control group n=845		P
	Number	Percentage	Number	Percentage	
Presbyopic	1848	70.9	634	75.0	0.52
Nonpresbyopic	758	29.1	211	25.0	0.52

Table 2: Presbyopia by age and gender

Age (years)	Male				Female				P
	Study group n=792		Control group n=305		Study group n=1056		Control group n=329		
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	
20-29	-	-	-	-	-	-	-	-	-
30-39	90	11.4	30	9.8	129	12.2	52	15.8	0.82
40-49	279	35.2	170	55.7	441	41.8	189	57.4	0.30
50-59	244	30.8	65	21.3	296	22.8	47	14.3	0.20
60-69	179	22.6	40	13.1	190	18.0	41	12.5	0.38

### Presbyopia by Magnitude

Subjects that required presbyopic addition of > +1.50DS to +2.00DS were in the majority in the two groups. The difference in the magnitude of presbyopia between the study and control groups was not statistically significant as shown in Table 3.

### Presbyopia and Use of Eye Glasses

In this study about 61.3% and 76.7% of study and control groups respectively had no presbyopic correction at all. There were statistically significant differences in the use and non-use of eye glasses between the study and control groups as shown in Table 4.

## AMETROPIA AND RISK FACTORS AFFECTING VISION

The present study revealed that 67.6% and 49.2% of ametropia in study control groups respectively used chloroquine as first-line drug for malaria. In the study group 62.2% and control group, 31.6% were in the habit of consuming food items of low nutritional value. About 33.6% and 27.4% of ametropics in the study and control groups respectively consumed alcohol while 19.9% and 15.1% of ametropics in the study and control groups used tobacco. 20% and 29.7% of ametropics in the study and control group respectively had past history of ocular trauma (Emerole *et al.*, 2011).

## DISCUSSION

Prevalence of Presbyopia in this study was 70.9% and 75.0% of study and control groups respectively. A prevalence of 97.7% presbyopia was found among drivers in public institutions in Ibadan, Nigeria (Bekibebe *et al.*, 2007). 65% and 68.1% presbyopia was reported among Ghanaian women and public senior high school teachers in the Kumasi metropolis, Ghana respectively (Kumah *et al.*, 2011). A prevalence of 55% was found in people aged ≥30 years in Southern India and Brazil (Duarte *et al.*, 2003; Holden *et al.*, 2008). In a survey of ocular morbidity among rural Ugandan adults, presbyopia was reported as the most common cause of visual impairment at near in that country for which

Table 3: Presbyopia by magnitude

Magnitude of presbyopia (addition at near)	Study group n=1848		Control group n=634		P
	Number	Percentage	Number	Percentage	
+1.00 D.S to+1.50 D.S	248	13.4	127	20.0	0.18
>+1.50 D.S to+2.00 D.S	720	39.0	294	46.4	0.32
>+2.00 D.S to+2.50 D.S	656	35.5	154	24.3	0.06
>+2.50 D.S to+3.00 D.S	224	12.1	59	9.3	0.49

Table 4: Presbyopia and use of eyeglasses

Use of eyeglasses	Study group n=2072		Control group n=649		P
	Number	Percentage	Number	Percentage	
Yes	802	38.7	138	21.3	0.01*
No	1270	61.3	511	78.7	0.01*

treatment was sought. Uncorrected presbyopia accounted for 48% of those presenting with visual impairment. Furthermore, in a study on the prevalence of presbyopia in Tanzania, it was found to be 62%. Koroye-Egbe, 2010 reported a prevalence of 45.05% in Bayelsa State, Nigeria. According to Borish 1975, a study on a comparison of genealogical influences in refractive status of Negroes and whites living in Panama about the amplitude of accommodation found that the Negroes suffered a quicker and much more abrupt loss of amplitude than did the whites, with the need for higher reading additions at an earlier age. The prevalence of presbyopia globally shows that presbyopia is universal (Duarte *et al.*, 2003; Holden *et al.*, 2008). The differences in prevalence of presbyopia as shown above is because there is no universally accepted definition of presbyopia. There is also no standardized technique to measure it. The prevalence of presbyopia will, therefore, depend on how it is defined, for example, the end point chosen and the distance at which near vision is tested (Patel and West, 2007).

The age at onset of presbyopia in more developed countries (Europe, New Zealand and Japan) is about 45 years while, in the less and least developed countries (Asia and Africa), it is about 40 years (Borish, 1975; Duarte *et al.*, 2010). Age is overwhelmingly the most important risk factor, but climate, geographic location, gender and ethnicity also contribute to the observed variation in the age at onset and degree of presbyopia. It is of note that some individuals, for a number of reasons, might underestimate their real age (Emerole, 1992; Emerole *et al.*, 2011; Holden *et al.*, 2008; Laviers *et al.*, 2010). Among subjects found to be presbyopic in the present study, females aged 40–49 were in the majority (57.1% and 51.9% of females in the study and control groups respectively were presbyopic). The higher prevalence of presbyopia in the female gender agrees with previous studies on presbyopia in low-and-middle-income countries (Patel and West, 2007).

It is reported that the amplitude decreased more rapidly in women than in men, particularly between the ages 45 and 50 years (Borish, 1975). Since this is the most common age of menopause with the associated physical, psychological and physiologic changes, glandular influence may also be of concern or may be contributory to this observation (Borish, 1975; Emerole *et al.*, 2011; Nworah and Ezepue, 1992; Weale, 2003). In a young person, the crystalline lens is soft and flexible. There is a decrease in tone of the ciliary muscles and gradual loss of accommodation after the age of 35. At  $\geq 40$  years of age the crystalline lens becomes more rigid (Borish, 1975; Duarte *et al.*, 2003). As the crystalline lens cannot change shape as easily as it once did, it becomes more difficult to read at close range. In the present study the dominant ametropia was hyperopia and the fact that age itself modifies a preexisting error making it more symptomatic may explain the higher prevalence of presbyopia in the 40–49 years age group in this study (Emerole *et al.*, 2011; Nworah and Ezepue, 1992).

The present study showed that 61.0% of subjects in both study and control groups were domiciled in the rural areas. There was no significant interaction between occupation and ametropia (presbyopia inclusive). Students were in the majority (22.9%) in the study group while skilled persons (21.5%) were in the majority in the control group. There were more literate subjects in the study group (41.8% of subjects in the study group had tertiary education). The findings in the present study establish the universality of presbyopia and the discomforts arising from presbyopia are not peculiar to the study or control group (Emerole *et al.*, 2011). Some notable factors affecting components of the refractive system and accommodative function are drugs, nutritional and environmental influences (Emerole, 1992; Emerole *et al.*, 2011; Wong *et al.*, 2001). In the present study 67.6% and 49.2% of ametropics in the study and control groups respectively used chloroquine as their regular antimalarial drug, especially subjects residing in the rural areas. Malaria is endemic in Nigeria. Abuse of chloroquine affects the visual system especially in the absence of adequate nutrition. Many of the ametropics (62.2% and 31.6% of study and control groups respectively were in the habit of consuming food items of low nutritional value). The effect of nutritional deficiencies on accommodation and visual function has been noted (Duarte *et al.*, 2003; Emerole *et al.*, 2011; Weale, 2003). From this study poor dietary habits, irrational use of the quines as antimalarial drug and environmental influences may be implicated as risk factors for presbyopia. It is not evident from our study that ocular trauma, the use of alcohol and tobacco significantly affect the prevalence of presbyopia.

In the present study subjects requiring addition at near of  $> +1.00DS$  to  $+2.00DS$  were in the majority (39.0%

and 46.4% of study and control groups respectively. This agrees with findings in a study on the distribution of presbyopic correction through primary health care centres in Zanzibar, East Africa (Laviors *et al.*, 2010). Spectacle powers of + 1.50DS and + 2.00DS and metal frames (61.9%) were most frequently dispensed. Majority (57.4%) were aged 40–50 (Laviors *et al.*, 2010). Overwhelmingly we found that the cost was the principal barrier to spectacle use, along with a lack of awareness among the subjects in this study. This featured more in the control group. It was observed that 61.3% and 76.7% of study and control groups respectively had no correction at all. Majority of those who were already using eyeglasses purchased/procured their eye glasses in the market (without proper eye examination). This was largely due to ignorance and the belief that it was more cost-effective and time-saving (Emerole *et al.*, 2011). In more developed countries, population without adequate optical correction is <16.0% while it is 61.0–70.0% in less developed countries and 74.0–94.0% in least developed countries (Duarte *et al.*, 2003; Holden *et al.*, 2008). About 670 million people worldwide are blind or visually impaired simply because they do not have access to an eye exam and eyeglass (Duarte *et al.*, 2003; Holden *et al.*, 2008). 30% of participants in a similar study in Brazil had correction that were ineffective (Duarte *et al.*, 2003). Furthermore, among drivers working in public institutions in Ibadan, Nigeria only 32.3% were current wearers of spectacle (Bekibele *et al.*, 2007). All this points to inadequate accessibility to optical services, socioeconomic and cultural factors also influence the decision on which medical facility to utilize and when.

## CONCLUSION

This study has provided information on prevalence and determinants of presbyopia in the adult population of Imo State, Nigeria. The level of prevalence was high compared with the levels in more developed countries like Europe, North America and Australia. The reason for this marked difference may be due to the identified poor level of nutrition, frequent use of chloroquine derivatives for the treatment of malaria, environmental factors as well as being domicile in the rural area.

The study has re-established the link of two physiological risk indicators of gender and age to the onset of presbyopia.

## RECOMMENDATIONS

Visual health education, regular vision screening (especially of persons over 35 years of age) and intervention (provision and distribution of low

cost/economically friendly spectacles, follow-up of recipients of spectacles and to ensure that persons with presbyopia were not under-corrected despite owning spectacles for near vision) are recommended because of the increasing importance of near vision tasks in socioeconomic development especially in low-income economies like ours.

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