

# Amplitude of accommodation and age of onset of presbyopia in South-East, Nigeria

## Abstract

**Objective:** To determine the amplitude of accommodation and age of onset of presbyopia among adults in Onitsha, South-East Nigeria.

**Materials and methods:** Participants were selected through multi-stage random sampling from 10 secondary schools in Onitsha. A pre-tested self-administered questionnaire was used to elicit information on participants' socio-demographic characteristics and ocular health. Ocular examination included distance and near visual acuity tests, refraction, external eye examination, funduscopy and measurement of amplitude of accommodation.

**Results:** Three hundred and forty teachers made up of 63 males (18.5%) and 277 females (81.5%) were studied. The age range was 24 – 60 years; mean:  $45.2 \pm 7.4$ SD years. The amplitude of accommodation ranged from 1.8 - 9.8 dioptres; mean:  $4.7 \pm 2.7$ SD dioptres.

**Conclusions:** Nigerian adults have lower amplitudes of accommodation than Caucasians of comparable age and may require presbyopic correction earlier than their Caucasian counterpart.

**Keywords:** amplitude, accommodation, presbyopia, adult, diopters

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## Introduction

Accommodation is the ability of eye to alter the refractive power of its crystalline lens so as to focus the image of a near object on the retina.<sup>1</sup> A measure of the eye's ability to do this is known as the amplitude of accommodation and is expressed in dioptres. This determines how clearly and comfortably an individual sees near objects. An individual's amplitude of accommodation therefore invariably affects his or her ability to do near work. Hence defects in amplitude of accommodation may drastically affect productivity and quality of life especially in those individuals whose occupations involve a lot of near work such as the teachers. Studies of amplitude of accommodation at various times and in various age groups and races using various methods showed that there is a progressive decline in the amplitude of accommodation with advancing age,<sup>2-6</sup> eventually leading to presbyopia. Amplitude of accommodation has also been found to be lower in Africans compared to Caucasians of comparable age.<sup>7</sup>

There are however variations in the rate of decline of amplitude of accommodation with age and age of onset of presbyopia in various races.<sup>2-4</sup> In Europeans, presbyopia sets in at about 46 years<sup>2</sup> while in Indians, presbyopia sets in earlier at about 37 ½ years.<sup>3</sup> In Chinese race, presbyopia occurs between 36 years and 40 years.<sup>4</sup> A study of presbyopia in Anambra state, Nigeria recorded that the youngest presbyope was aged 37.<sup>8</sup>

Prospectively determining the age of onset of presbyopia will ensure the availability of a solid data base on the subject which will guide the policy on presbyopic correction. Prompt, effective and appropriate correction of presbyopia, on the other hand will enhance the capacity for prolonged near work among the affected adults. The aim of this study was to determine the amplitude of accommodation and age of onset of presbyopia in adults in Onitsha, Nigeria.

## Materials and methods

This was a cross-sectional study. Participants who were secondary school teachers were selected by multistage random sampling technique from 10 public secondary schools in Onitsha, Nigeria. Data was collected from study subjects by a combination of pre-tested self-administered structured questionnaires, clinical examinations and clinical measurements.

After obtaining informed consent, each participant completed a self-administered questionnaire on socio-demographic data and ocular health. The distance visual acuity (aided and unaided) of each eye of each participant was measured at 6 meters using the Snellen's chart. The near acuity was then determined for each eye of each subject at 33 centimeters using a Times Roman font near chart. Ocular examination of each eye of each participant involved pen torch for external eye examination, direct ophthalmoscopy and streak retinoscopy (refraction). Subjective refraction was done and best lens correction given. The amplitude of accommodation was measured using the near point of accommodation method<sup>5-9</sup> as follows:

The participant wore a trial lens frame with appropriate distance correction in place. One eye was occluded with an occluder. The zero mark of a 50 centimetres rule was placed on the lateral orbital rim of the eye to be tested, by an assistant. The subject was then asked to fixate and attempt to read the N5 prints of a rigid near chart held 50 centimetres away from him/her. The near chart was then brought slowly closer to the subject until he/she complained of blurring; the chart was then moved away slowly from the subject until he / she again said the prints were clear. The near chart was held in place at that point and the reading on the 50 centimetres rule from the lateral orbital rim to the near chart was recorded as the subject's near point of accommodation. The reciprocal of this near point of accommodation in meters was then noted as the subject's amplitude of accommodation in dioptres

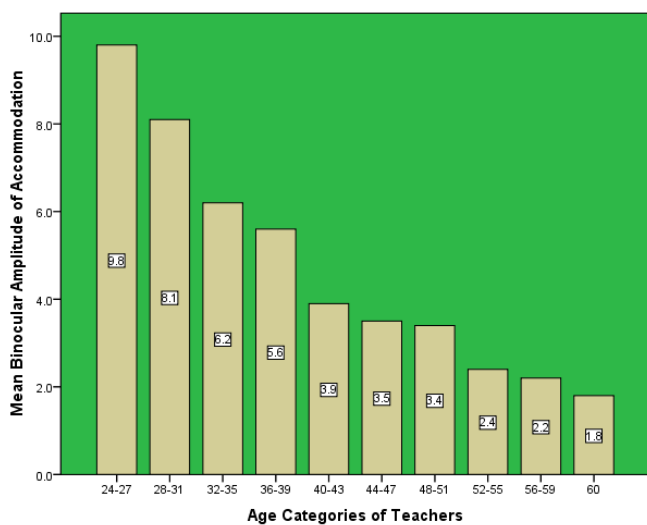
since he/she was emmetropic or rendered emmetropic by correction. For those who could not read the N5 print at 50 centimetres, a plus 3 dioptres lens was placed in the trial frame with the distance correction still in place if any. This placed the far point at 33 centimetres and brings the near point correspondingly 3 dioptres closer.<sup>10</sup> The same procedure was carried out and plus 3 dioptres was subtracted from the final result to get the exact amplitude of accommodation. The whole procedure for measuring amplitude of accommodation was then repeated for the other eye and then both eyes.

For this study, presbyopia was defined as amplitude of accommodation equal to or less than four dioptres ( $\leq 4D$ ).<sup>6</sup> Data analysis was with descriptive and inferential statistics. The student's t-test and 95% confidence interval were used to explore the association between some variables, with the alpha level at 0.05.

### Results

Three hundred and forty school teachers, comprising 277 (81.5%) females and 63 (18.5%) males were studied. The age range was 24-60 years; mean:  $45.2 \pm 7.5SD$  years.

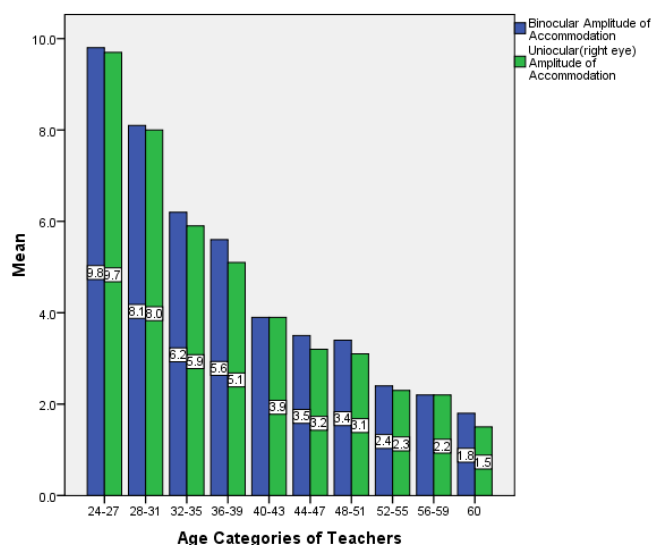
Figure 1 is a bar chart showing the mean amplitude of accommodation at various age groups of the participants. It shows progressive decrease in the amplitude of accommodation with advancing age. The greatest rate of decline in the amplitude of accommodation (1.9D) was in the 28–35 year age bracket which was 3 times the decline (0.6D) in the 52–60 year age group.



**Figure 1** A Bar Chart Showing the Mean Amplitude of Accommodation at Various Age Categories.

Average amplitude of accommodation of 4D was found at 38 years. Thirty-eight years was therefore taken as the age of onset of presbyopia among this cohort. Figure 2 shows the difference between binocular and unioocular amplitudes of accommodation. The mean binocular amplitude of accommodation is significantly higher than the unioocular amplitude ( $t=4$ ;  $df=9$ ;  $sig=0.003$ ). The greatest difference was observed in the age group 36-39 years.

Two hundred and sixty nine participants (79.1%) were adjudged presbyopic (amplitude of accommodation  $\leq 4.0D$ ), with 255 (75%) complaining of serious difficulty with near work; 223 (65.6%) were using reading glasses. The prevalence of presbyopia among these adults was therefore 79.1% (95% CI= 74.7-83.5).



**Figure 2** A Compound Bar Chart Comparing Binocular and Unioocular amplitudes of accommodation.

### Discussion

The result of this study showed a progressive decline in the amplitude of accommodation with advancing age. This is in agreement with the findings of Duane,<sup>2</sup> Edward,<sup>4</sup> Rambo<sup>3</sup> and Chattopadhyay<sup>6</sup> in the Europeans, Chinese and Indians respectively. Method of measurement of amplitude of accommodation seems to have no effect on this observed pattern since same pattern was observed by Chattopadhyay<sup>6</sup> who used the Royal Air Force near point rule in his measurement.

Table 1 shows the amplitudes of accommodation for age as found by various authors. The amplitudes of accommodation found in the present study are comparable to those of Duane<sup>2</sup> at 25 years and 30 years. However at age 40, the amplitude of accommodation is much lower in the present study (3.9D) compared to that of Duane<sup>2</sup> (6D). At ages 50 and 60, the amplitudes of accommodation in the two studies are again comparable. The observed difference may be due to racial differences. The present study was conducted in Nigerian Africans while Duane's study was in Europeans. Rambo<sup>3</sup> had observed that the amplitude of accommodation declined more rapidly in Indians than Europeans after age 15. The present study however, did not include subjects as young as 15 years. The amplitudes of accommodation in the present study are comparable to that of Chattopadhyay<sup>6</sup> only at ages between 40 and 60. The observed differences again could be due to racial variation between the Indians and Africans. The amplitude of accommodation in the present study and that of Iwuagwu<sup>11</sup> are comparable only at 40 years. This is surprising as both studied similar population groups in South-East Nigeria. Iwuagwu's study was however on students and staff of a university and did not include individuals as old as 60 years.

In line with previous observations, binocular amplitudes of accommodation as found in the present study were higher than unioocular amplitudes. However, the maximum difference of 0.4 found in the present study is lower than that documented in the literature (0.5-1.0D).<sup>12</sup>

The age of onset of presbyopia as found in the present study is 38 years with a prevalence of 79.1% (95% confidence interval=74.7-83.5).

There was no significant difference in the age of onset of presbyopia between the male and females. This age of onset of presbyopia (38 years) contrasts with the findings of Duane, who documented 46 years as the age of onset of presbyopia in Europeans.<sup>13</sup> The 38 years age of onset of presbyopia is similar to Nwosu's<sup>8</sup> finding in a study of presbyopia in Anambra state, Nigeria. He recorded that the youngest presbyope was aged 37 years. Olurin<sup>14</sup> however recorded a lower age of 35 years in a clinic study at Ibadan, Nigeria. A similar age

(to the present finding) of 37 ½ years was recorded by Rambo as the age of onset of presbyopia in Indians. Still in India Chattopadhyay et al.,<sup>6</sup> recorded a lower age of onset of presbyopia. According to them, presbyopia is reached at 35 years in the Indian people. A similar age of onset of presbyopia to the present finding was also observed by Edward et al.,<sup>4</sup> in Chinese people. Presbyopia in Chinese race, according to them, occurs between 36 years and 40 years.

**Table 1** Amplitude of accommodation for age as found by various authors

		Amplitude of accommodation by various authors			
		Duane <sup>2</sup>	Chattopadhyay <sup>6</sup>	Iwuagwu <sup>11</sup>	Present study
Age in years	25	9.8	8.1	8.3	9.8
	30	8.5	6.3	6.1	8.1
	40	6	3.3	4	3.9
	50	2.8	1.7	1.4	3.2
	60	1.5	1.3		1.8

The much earlier age of onset of presbyopia in the present study compared to the Europeans may be attributable to racial variations since basically the same method (Near point of accommodation method) was used in the two studies. The African, Indian and the Chinese may have some racial similarities in the factors determining accommodative amplitude and onset of presbyopia since the three races have a fairly similar and lower age of onset of presbyopia. Further studies are needed to determine the racial factors that influence amplitude of accommodation and age of onset of presbyopia.

In conclusion, Nigerian adults have lower amplitudes of accommodation than Caucasians of comparable age especially in the thirties and forties age groups. Presbyopia starts early at about the age of 38 years in Nigerian adults. Therefore Nigerian adults should be offered presbyopic correction earlier than their Caucasian counterpart. This will go a long way to improving the quality of lives of these adult Nigerians, especially those individuals whose activities of daily living involve a lot of near work.

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## Conflicts of interest

There are no financial conflicts of interest.

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