

Age, Amplitude of Accommodation and Near Addition Power of Adult Nigerians

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Abstract

This study was undertaken to determine the relationship among age, amplitude of accommodation (AA) and near additional add power in Nigerian adults. A cross sectional study was undertaken in 297 adults comprising 158 (53.3%) males and 139 (46.8%) females and aged 33 – 89 years. Amplitude of accommodation was measured using the push up method and the near addition power was determined using the plus lens to clear near vision method. Multivariate analysis was used to determine the relationship among the age of the participants, amplitude of accommodation and near add power. The mean age of the participants was 52.9 ± 11.5 years (95% confidence interval = 51.6 – 54.2). The mean amplitude of accommodation was 2.07 ± 1.19 D (95% confidence interval = 1.93 – 2.21) while the mean add power was 2.06 ± 0.57 D (95 % confidence interval = 2.00 – 2.12). There was a strong negative correlation between AA and age ($r = -0.879$, $p < 0.001$), between AA and near add power ($r = -0.777$, $p < 0.001$) and a strong positive correlation between near add power and age ($r = 0.813$, $p < 0.001$). There is an inverse relationship between AA and age and between AA and near add power and a direct relationship between age and near add power for Nigerian adults

Keywords: Presbyopia, amplitude of accommodation, near addition power, age, Nigerians

Introduction

When an individual changes fixation from a distance to a near fixation target, the optical system of the eye has the ability to increase its focusing power. This enables the eye to bring the image of the object to a clear focus on the retina. This ability is referred to as accommodation¹⁻³ and the maximum amount of accommodation an individual is able to exert is known as the amplitude of accommodation (AA). Following the studies of Donders⁴, Duane⁵ and other researchers⁶⁻⁸, the amplitude of accommodation has been found to decrease with increasing age.

This age related decrease in amplitude of accommodation continues until such a point when the individual is unable to exert sufficient accommodation to bring a near fixated object to focus. This state is known as presbyopia, thus necessitating the need for an additional converging lens either as a spectacle addition or as presbyopic contact lens correction. Various authors⁹⁻¹² have reviewed the various methods of determining this additional power and have concluded that the additional power increases with increasing age as the amplitude of accommodation declines.

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Whereas studies have reported presbyopic addition correction for different population groups, there are few studies evaluating the relationship between age, the amplitude of accommodation and near addition for Nigerian subjects.

In a study of bifocal adds in Nigeria, Kragha reported that females had higher add powers compared to males; a result he attributed to the shorter stature of females compared to males rather than sex difference in amplitude of accommodation¹³. Defining the onset of presbyopia as “the need for an addition of +1.00D”, he reported the mean age of onset of presbyopia to be 38.4 years and 39.8 years for males and females respectively. This study was designed to investigate the relationship among age, the amplitude of accommodation and near addition power for correcting presbyopia for Nigerians adults.

Methods

A prospective cross-sectional study was undertaken to investigate the relationship among age, the amplitude of accommodation and near addition power in adult Nigerians. Participants for the study were drawn from the General Hospital and the Specialists Eye Centre, Agbor. These health facilities are the major referral hospital serving adults in Delta, Edo and Anambra States in South-East and South-South Nigeria. Every consecutive adult visiting the hospital over the study period who met the inclusion criteria and gave consent to participate were recruited for the study. Participants were included in the study if they complained of a difficulty reading fine prints and therefore requires near addition power, had no ocular pathology that precludes the measurement of AA and the prescription of near addition add power. Each study participant had a complete eye examination including comprehensive ocular history, distance and near visual acuity, ocular health examination as well as subjective refraction. The amplitude of accommodation

was measured while the patient was wearing full subjective correction for distance vision using the push-up method. A +2.00 D lens was placed in the trial frame so the patient could see the near point card (N6) which was used as the target. The amplitude of accommodation was measured by bringing the near point card toward the patients until the point of “first sustained blur” was reported by the patient. The measurement was made from the spectacle plane. Near addition was determined using the plus lens to clear near vision method¹⁴.

The procedures were carried out according to prescribed clinical protocols and the study was conducted in accordance with the guidelines of the Helsinki Declaration on research involving human subjects. The results of the age, AA and near add power was reported as a mean \pm standard deviation with the 95% confidence interval. The Student's t-test was used to test the sex difference in the measured variables. Multivariate analysis was used to examine the relationship among age, AA and near add power. Data analysis was performed using SPSS version 21.

Results

A total of 297 subjects comprising 158 (53.2%) males and 139 (46.8%) females and aged 33 – 89 years with a mean age of 52.9 ± 11.5 years (95% confidence interval = 51.6 to 54.2) were examined for the study. The mean age of the male subjects was 55.6 ± 11.7 years (95% confidence interval = 53.8 to 57.5) and range from 35 – 89 years while that of the female was 49.8 ± 10.4 years (95% confidence interval = 48.1 to 51.6 years) and range from 33 – 86 years. There was a significant difference between the mean age of male and female subjects ($p < 0.0001$). Table 1 shows the age and sex distribution of the study participants.

The amplitude of accommodation ranged from 0.25 – 5.00 D with a mean of 2.07 ± 1.19 D (95% confidence interval = 1.93 to 2.21 D). The mean amplitude of accommodation for the males was 1.81 ± 1.09 D

13. Kragha I K O K. Bifocal adds in Nigeria. *Am J Optom Physiol Opt.* 1985;62(11):781 - 785.

14. American Optometric Association. *Optometric Clinical Practice Guideline: Care of the patient with presbyopia.* St Louis: American Optometric Association, 2011.

(95% confidence interval = 1.64 – 1.99 D) while that of the female was 2.36 ± 1.22 D (95% confidence interval = 2.16–2.57 D). The amplitude of accommodation of the female subjects was significantly more than that of the male subjects ($p < 0.0001$). The amplitude of accommodation by sex is presented in Table 2. The amplitude of accommodation declined from 4.19 D in the third decade of life to 0.42 D in the eight decades (Table 3).

The near add power of the 297 participants range from 1.00 – 3.50 D with a median of 2.00 D and a mean of 2.06 ± 0.57 D (95% confidence interval = 2.00 – 2.12 D). The mean near add power of the males was 2.16 ± 0.59 D (95% confidence interval = 2.07 – 2.27 D) while that of the females was 1.95 ± 0.52 D (95% confidence interval = 1.86 – 2.04 D). The range for both males and females was 1.00 – 3.50 D. There was a significant difference between the mean near add power of males and females ($p < 0.001$). (Table 4)

There was a strong negative correlation between the amplitude of accommodation and age ($r = -0.879$, $p < 0.001$) and a strong positive correlation between near add power and age ($r = 0.813$, $p < 0.001$). There was a strong negative correlation between the amplitude of accommodation and near add power ($r = -0.777$, $p < 0.001$). Univariate analysis showed that the amplitude of accommodation decline at a rate of 0.09 D per year while the near add power increased at a rate of 0.04 D per year. Figures 1 and 2 show the scatter plot of the amplitude of accommodation and near add power with age respectively.

Analysis of variance indicated that there was a significant difference in the mean near add power with age group. Table 5 shows the mean near add power for different age group.

Table 6 shows the multivariate analysis of association among near add power, age and amplitude of accommodation.

Near add power = $0.83 + 0.028(\text{age}) - 0.131(\text{AA})$

Discussion

Population and clinical studies on presbyopia in Nigeria have largely examined its epidemiology^{13, 15-16} and age of onset^{13,15}. The present study examined the relationship among age, AA and near addition power in Nigerian adult population.

There were 297 subjects in this study with AA declining from a mean of 4.17 ± 0.54 D in those aged 30 – 39 years to 0.42 ± 0.18 D in those aged 70 – 79 years while the mean add power increased from $+1.34 \pm 0.23$ D in those aged 30 – 39 years to $+2.95 \pm 0.31$ D in those aged 70 – 79 years. One subject each was aged 83 years and 86 years with a near add power of $+2.25$ D and $+3.00$ D respectively though both have an amplitude of accommodation of 0.25 D. It has been reported¹⁷ that for all intents and purposes, the AA is believed to decline to zero at about age 60 years and any measured AA thereafter is a measure of depth of focus rather than AA.

There was a significant difference in AA and near add power for males and females. This difference reflects the difference in the mean age of males and females as the females were significantly younger than the male subjects in this study. As Kragha¹³ has pointed out the difference in near add between males and females is not related to any gender difference in AA but as a result of the smaller stature of females compared to males which necessitate female to read at a comparably closer working distance than male. This is further supported by the fact that females required relatively lower add power compared to males who were reported to be significantly older and therefore had lower AA compared to the females in this study.

On the average, the study showed that the add power changed by approximately 0.30 D every ten years with the highest change occurring between 40 – 49

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and 50 – 59 years (0.58 D). There was a dramatic change for subjects in the age group 70 – 79 and 80 – 89 years. In this case there was a change of – 0.07 D. The relative lower add power recorded for participants aged 80 – 89 years compared to those aged 70 – 79 years may relate to the so-called “second sight” which is due to senile miotic pupils leading to slightly improved vision in the elderly. Blyston reported that the near add increased rapidly in patients from age 40 to 50 years and more slowly after 50 years¹⁷. Though the present study revealed this pattern of a less rapid increase in add power in the older subjects, the decline was not uniform in this study. This may be due to different sample sizes used in the studies. Pointer noted that there was a deceleration in add power requirement beyond an individual’s mid-fifties¹⁸.

The add power reported in this study appear to be slightly higher compared to other studies in Iran

and among Caucasians^{19,20}. In Iran, the mean add power for subjects with a mean age of 50.2 years was 1.57 D with add power ranging from 0.29 D for subjects 35 – 40 years to 2.57 D for those aged 66 – 70 years. This difference may be due to the different methods employed in determining the near add power. Yekta, et al¹⁹ calculated the add power by deducting half the measured AA from 3.00 D (the accommodative demand for a 33 cm test distance). In the present study, the add power was determined using the minimum plus required to clear near vision¹⁴. This method gave the actual near addition power rather than the calculated add power employed in the Iranian study. For the Caucasian study, the add power was 2.59 D and 2.71 D for males and females respectively in subjects 76 – 80 years²⁰.

Conclusion

This study reported the relationship between age, AA and near add power among Nigerian adults in Ika South Local Government Area of Delta State. The study demonstrated the inverse relationship between AA and age as well as between AA and near addition power for Nigerian adults. The near addition power was found to be somewhat higher compared to studies for other populations. There was a difference in near add power and AA in male and female subjects which was related to the difference in the age of male and female.

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Table 1
Age and sex distribution of study participants

Age group (years)	Sex		Total n (%)
	Male n (%)	Female n (%)	
30 – 39	5 (3.2)	18 (12.9)	23 (7.7)
40 – 49	50 (31.6)	56 (40.3)	106 (35.7)
50 – 59	47 (29.7)	39 (28.1)	86 (29.0)
60 – 69	32 (20.3)	19 (13.7)	51 (17.2)
70 – 79	21 (13.3)	4 (2.9)	25 (8.4)
80 – 89	3 (1.9)	3 (2.2)	6 (2.0)
Total	158 (100.0)	139 (100.0)	297 (100.0)

Table 2
Distribution of amplitude of accommodation by gender

Amplitude of accommodation (D)	Sex		Total n (%)
	Male n (%)	Female n (%)	
0.25 – 1.24	35 (22.2)	17 (12.2)	52 (17.5)
1.25 – 2.24	77 (48.7)	57 (41.0)	134 (45.1)
2.25 – 3.24	18 (11.4)	19 (13.7)	37 (12.5)
3.25 – 4.24	24 (15.2)	36 (25.9)	60 (20.2)
4.25 – 5.24	4 (2.5)	10 (7.2)	14 (4.7)
Total	158 (100.0)	139 (100.0)	297 (100.0)

Table 3
Distribution of amplitude of accommodation by age group

Age group	Mean AA \pm SD (D)	95% confidence interval
30 – 39	4.19 \pm 0.54	3.94 – 4.41
40 – 49	2.90 \pm 0.81	2.75 – 3.06
50 – 59	1.62 \pm 0.39	1.54 – 1.71
60 – 69	1.17 \pm 0.36	1.07 – 1.27
70 – 79	0.42 \pm 0.18	0.35 – 0.50
80 – 89	0.25 \pm 0.00	0.25

Table 4
Distribution of near add power of respondents

Near add power (D)	Sex		Total n (%)
	Male n (%)	Female n (%)	
1.00 – 1.49	16 (10.1)	20 (14.4)	36 (12.1)
1.50 – 1.99	38 (24.1)	44 (31.7)	82 (27.6)
2.00 – 2.49	38 (24.1)	40 (28.8)	78 (26.3)
2.50 – 2.99	46 (29.1)	28 (20.1)	74 (24.9)
3.00 – 3.49	20 (12.7)	7 (5.0)	27 (9.1)
Total	158 (100.0)	139 (100.0)	297 (100.0)

Table 5
Mean near add power for different age group

Age group	Mean ± SD (D)	95% confidence interval	Change in add power (D)
30 – 39	1.34 ± 0.23	1.24 – 1.44	-
40 – 49	1.64 ± 0.31	1.58 – 1.70	0.30
50 – 59	2.22 ± 0.34	2.15 – 2.29	0.58
60 – 69	2.51 ± 0.32	2.42 – 2.60	0.29
70 – 79	2.90 ± 0.42	2.73 – 3.07	0.39
80 – 89	2.83 ± 0.33	2.40 – 3.20	- 0.07

Figure 1:
Relationship between amplitude of accommodation and age

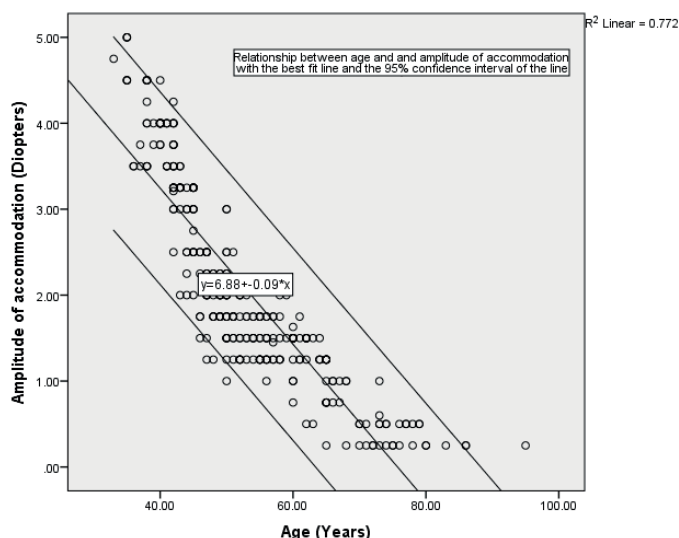


Table 6
Multivariate analysis of association among near addition power, age and amplitude of accommodation

Parameter	Regression coefficient B	Standard error	Standardized coefficient of beta	p-value
Age (years)	0.028	0.003	0.572	< 0.001
Amplitude of accommodation (D)	- 0.131	0.33	- 0.274	< 0.001

Figure 2
Relationship between age and near addition power

