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Research Article

ACCOMMODATION LAG AMONG CORRECTED MYOPES AND EMMETROPES: A COMPARATIVE STUDY

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ABSTRACT

Accommodation lag is the amount by which the accommodative response of the eye is less than the dioptric stimulus to accommodation. This study was carried out at the Optometry Teaching Clinic, Federal University of Technology, Owerri, Nigeria to compare the accommodation lag of corrected myopes and emmetropes. A total of 68 subjects between the ages of 18 and 30 and a mean age of 23.15±2.85 were used for this study. The accommodation lag was determined by taking the difference between the static and dynamic retinoscopic findings of each subject. Results obtained showed that 18(26.47%) myopes recorded a value of between -0.25DS and -1.00DS for both static and dynamic retinoscopy. For a finding of -1.25DS to -2.00DS, there were 7(10.29%) and 8(11.76%) myopes for static and dynamic retinoscopy respectively. The distribution of retinoscopic findings among emmetropes showed that 17(25%) and 7(10.30%) emmetropes recorded a value of between plano and -0.25DS for static and dynamic retinoscopy respectively. For a finding of +0.25DS to +0.50DS, there were 16(23.53%) and 20(29.41%) emmetropes for static and dynamic retinoscopy respectively. The mean value for accommodation lag among the myopes was 0.35±0.24D. For the emmetropes, the mean accommodation lag was 0.24±0.27D. Data analysis with SPSS version 21 using the Independent Sample T test revealed that there was no significant difference (P>0.05) in accommodation lag between the corrected myopes and the emmetropes used in this study. Myopes were advised to always put on their prescription glasses to ensure an improvement of their accommodative response.

INTRODUCTION

Myopia is a progressive visual disorder that results in poor distance vision. In addition to poor distance vision, it also changes the physical structure of the eye. It can steepen the front surface of the cornea or stretch the retina[1]. These changes increase the risk of future eye diseases. It is one of the leading causes of blindness around the world and has a direct association with retinal detachments and glaucoma[2]. Myopia definitely has a genetic link. However, it is driven more by the environmental stress of near work such as reading, studying, computer usage, hand games and lack of outdoor time. Myopia and its progressive disorders can cause abnormal or adverse ocular changes. High myopia may cause thinning or weakening of the retina. Abnormal stretching or elongation of the eye may pull on the vitreous which in turn pulls on the retina leading to its detachment[3]. A detached retina can lead to blindness. The elongation process can also cause "lattice-like" holes to occur in the peripheral retina. These holes can allow fluid to seep under the retina, lifting and detaching it[3]. Moderate to high myopic people are twice as likely to develop glaucoma[4]. Emmetropia on the other hand, is the state of vision where a faraway object at infinity is in sharp focus with eye lens in a neutral or relaxed state[1]. This condition of the normal eye is achieved when the refractive power of the cornea and the axial length of the eye balance out, which focuses rays of light on the retina, resulting in clear vision.

Accommodation lag is the difference between accommodative demand and accommodative response. It is the amount by which the accommodative response of the eye is less than the dioptric stimulus to accommodation[5]. Accommodative response is a measure of the actual accommodation that occurs when an object is presented to the eye[5]. A lag of accommodation occurs when a person focuses on the plane of an object but the eyes actually focuses at a point farther away

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behind it. Dynamic retinoscopy quantifies the accommodative lag by determining the refractive state of an accommodating eye. The lag of accommodation depends on the depth of focus of the eye[1].Using the Canon R-1 auto refractor, Donald *et al*.[6] found that myopic children accommodated significantly less in response to blur induced by negative lenses thanemmetropic children. Since lag of accommodation place the plane of best focus behind the retina, just like negative lenses, they proposed that the effect of both on myopia development could be similar. Accommodation errors were also measured in young adult emmetropic and myopic subjects, again using the Canon autorefractor R-1[7]. It was found that myopes accommodated less than emmetropes although the slopes of the individual accommodation response functions were correlated with refractive error only in the first of both studies which, in contrast to the other, used binocular stimulation. This study compares the accommodation lag of corrected myopes who wear their prescription glasses with emmetropes.

Experimental Section

This research was a clinical study carried out at the Optometry Teaching Clinic, Federal University of Technology Owerri, Nigeria. A total of 68 subjects comprising 33 males and 35 females were used for this study. Subjects who satisfied the inclusion and exclusion criteria were selected for the study. This included people between 18 and 30 years who did not have any debilitating systemic disease, ocular pathology, mental problem and people who gave an informed consent to be part of the study. The simple random sampling technique was adopted to select the subjects.An ethical approval for this study was obtained from the ethical committee of the Faculty of Health Technology, Federal University of Technology, Owerri, Nigeria. Case history, slit lamp biomicroscopy and ophthalmoscopy were carried out to determine subjects who passed the inclusion criteria. Emmetropes and corrected myopes were identified and put in two groups. The accommodation lag was determined by taking the difference between the static and dynamic retinoscopic findings. Data was uploaded into the Statistical Package for Social Sciences (SPSS) version 21. The unpaired sample T-test was used to test the null hypothesis at 0.05 level of significance and 95% confidence interval.

RESULT AND DISCUSSION

Out of the 68 subjects used in this study, 33(48.52%) were males while 35(51.48%) were females (Table 1).

Table 1 Age and gender distribution of subjects

Age group	Males n (%)	Females n (%)	Males and Females n (%)
18-20	7(10.29)	9(13.23)	16(23.52)
21-23	9(13.23)	12(17.65)	21(30.88)
24-26	11(16.18)	11(16.18)	22(32.36)
27-29	5(7.35)	2(2.94)	7(10.29)
30-32	1(1.47)	1(1.47)	2(2.94)
Total	33(48.52)	35(51.48)	68(100)

The Table also showed a distribution of the age group values for the males and females. The mean age of the males was 23.77 with a standard deviation of 3.25. The mean age of females was 22.53 with a standard deviation of 2.44. The mean age of all the subjects was 23.15 with a standard deviation of 2.85. This is shown in Table 2.

Table 2 Statistical values of age values

Gender	n	Range	Min.	Max.	Mean	S.D
M	33	12	18	30	23.77	3.25
F	35	9	18	29	22.53	2.44
M + F	68	12	18	30	23.15	2.85

M - Male; F - Female; Min. - Minimum; Max. - Maximum; S.D - Standard Deviation

The subjects were divided into two groups. Myopes who were in one group were 35(51.47%) in number; including 16(23.53%) males and 19(27.94%) females (Table 3). Emmetropes on the hand were 33(48.53%) in number comprising 17(25%) males and 16(23.53%) females. This is also shown in Table 3.

Table 3 Distribution of Myopes and Emmetropes used in the study

Refractive Status	Males n (%)	Females n (%)	Males and Females n (%)
Myopes	16(23.53)	19(27.94)	35(51.47)
Emmetropes	17(25.00)	16(23.53)	33(48.53)
Total	33(48.53)	35(51.47)	68(100.00)

The distribution of the retinoscopic findings among the myopes is shown in Table 4. From the Table, 18(26.47%) myopes recorded a value of between -0.25DS and -1.00DS for both static and dynamic retinoscopy. For a finding of -1.25DS to -2.00DS, there were 7(10.29%) and 8(11.76%) myopes for static and dynamic retinoscopy respectively. For a finding of -2.25DS to -3.00DS, there were 6(8.82%) and 5(7.35%) myopes for static and dynamic retinoscopy respectively. For a finding of -3.25DS to -4.00DS, there were 4(5.88%) myopes for both static and dynamic retinoscopy.

Table 4 Distribution of Retinoscopic findings among Myopes

Lens Power (DS)	Static Retinoscopy n(%)	Dynamic Retinoscopy n(%)
-0.25 - -1.00	18(26.47)	18(26.47)
-1.25 - -2.00	7(10.29)	8(11.76)
-2.25 - -3.00	6(8.82)	5(7.35)
-3.25 - -4.00	4(5.88)	4(5.88)
Total	35(51.47)	35(51.47)

The distribution of retinoscopic findings among emmetropes is shown in Table 5. From the Table, 17(25%) and 7(10.30%) emmetropes recorded a value of between plano and -0.25DS for static and dynamic retinoscopy respectively. For a finding of +0.25DS to +0.50DS, there were 16(23.53%) and 20(29.41%) emmetropes for static and dynamic retinoscopy respectively. For a finding of +0.75DS to +1.00DS, there were 6(8.82%) emmetropes for dynamic retinoscopy and none for static retinoscopy. The mean value for accommodation lag among the myopes was 0.35D with a standard deviation of 0.24. For the emmetropes, the mean accommodation lag was 0.24D with a standard deviation of 0.27. Data analysis with SPSS version 21 using the Independent Sample T test at 0.05 level of significance and 95% confidence interval revealed a P value of 0.816. This meant that there was no significant difference (P>0.05) in accommodation lag between the corrected myopes and the emmetropes used in this study.

Table 5 Distribution of Retinoscopic findings among Emmetropes

Lens Power (DS)	Static Retinoscopy n(%)	Dynamic Retinoscopy n(%)
0.00- -0.25	17(25.00)	7(10.30)
+0.25- +0.50	16(23.53)	20(29.41)
+0.75- +1.00	0(0.00)	6(8.82)
Total	33(48.53)	33(48.53)

Table 6 Statistical values on Accommodation of Lag of Myopes and Emmetropes

Refractive Status	Min.	Max.	Mean	S.D
Myopes	0.25	0.75	0.35	0.24
Emmetropes	0.50	0.75	0.24	0.27

Min. - Minimum; Max. - Maximum; S.D - Standard Deviation

Accommodation lag was slightly higher in myopes than the emmetropes even though the difference was not significant. The well-established association between myopia progression and near work has led to the speculation that a larger accommodative lag reported in myopes may be an important factor in its pathogenesis[8]. Assessing accommodative function is a vital component of understanding the myopia profile of a patient. Myopia progression in children and adults can be influenced by binocular function[9]. There is a speculation regarding accommodative lag prior to onset of myopia. Seidmann and Schaeffel[10] reported higher accommodative lag in progressing myopes using a photo refractor regardless of their starting point of refraction. Some other studies [11-13] do not show any significant difference in accommodation lag with different refractive errors. The difference in the stability of the accommodative behavior between individuals with different refractive states suggests a possible relationship between variability in accommodation and the development of myopia. This was supported by Harb *et al*[14] conducted a study on the characteristics of accommodative behavior during sustained reading in emmetropes and myopes and found that accommodative responses, errors and variability were related to accommodative demand and refractive error.

Accommodation lag and variability increases with closer demand. Myopes have greater variability in their accommodation responses compared to emmetropes and have larger accommodation lags at further reading distances[15]. This increased variability could result in an increase in retinal blur for both near and far targets. If the retinal image of an object is not clearly focused, the resulting blur is thought to cause the continued lengthening of the eyeball during development causing a permanent refractive error[16]. Both lag of accommodation, especially for near targets, and greater variability in the accommodative response has been suggested to cause the increased retinal blur. Greater variability in accommodative response has been demonstrated in adults with late-onset myopia but has not been tested in children[17]. Though no significant difference was found in the accommodation lag between myopes and emmetropes, studies[18-20] have tried to relate progressive myopia with accommodation lag. Constant wearing of their prescription glasses will improve the accommodative response among myopes.

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