

Impact of Ocular Stress on Axial Length of the Eye Among Young Adults

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ABSTRACT

As our eyes face a new breadth of ocular stressors, it becomes imperative to understand and properly diagnose ocular effects related to stress. This study was aimed at determining the effect of stress on the axial length of young adults. 50 subjects of both sexes and between the ages of 15-32 years (mean age of 20.98±3.65 years) were involved in the study. Comprehensive ocular examination including visual acuity using Snellen chart, examination of the anterior segment using penlight, funduscopy using direct ophthalmoscope and ophthalmometry using a one position keratometer to measure the radius of curvature of the cornea of each eye was carried out on all the subjects. The axial length of the subjects was

measured twice through ultrasonography using the A-SCAN ultrasound machine. The cumulative mean baseline axial length of the subjects was 23.11mm while the mean induced value was 23.86mm showing an increase in axial length of +0.75mm after exposure to stress. There was a statistically significant ($P < 0.05$) diurnal variation in axial length due to exposure to stress. This signifies a strong correlation between ocular stress and axial length. Stress reduction procedures which involve relaxation should be practised frequently to reduce eyestrain, fluctuations in the eyes axial length and ensure visual clarity.

KEYWORDS: Ocular stress; Axial length; Eye; Young Adults

INTRODUCTION

Stress is a physical, mental or emotional reaction caused by a change that disturbs or interferes with the body's normal equilibrium¹. The ocular impact of stress may range from mild discomfort to severe, debilitating vision loss. Various lifestyle factors and activities can induce ocular stress, such as prolonged near work, working longer hours and using more technology. As technology continues to advance, it is difficult to escape the need to use our eyes more frequently and for longer periods of time. Most people are however not aware of the impact of stress on their visual health and function. Perception is inseparable from stress response, what we perceive and how we handle it in any given situation involves the entire body system. While key life experiences and major events can have a greater impact on us than everyday events, all life's interaction can be stressors. A stress response begins when we perceive any stimulus as overwhelming or as a threat. The sympathetic branch of the autonomic nervous system (ANS) initializes the stress response also known as the fight or flight response which is common during arousal exercise, when we stand up or experience ocular stress². A prolonged state of arousal with the sympathetic system

engaged, can lead to adrenal exhaustion and fatigue (stress) which can cause several ocular changes. Chronic pupil dilation and light sensitivity are common ocular indications of a system that is sympathetically dominated or stressed^{2,3}.

Ocular stress may arise from near work demands, such as sustained computer and visual display terminals (VDT's) use^{4,5} and from exposure to glare⁶. Ocular stress caused by working with a VDT may cause an autonomic imbalance that alters pupil size, accommodation and lacrimation^{2,3}. Some near work demands are incompatible with our physiological capabilities, and therefore provoke a stress response in which our eyes converge closer than accommodation⁴. The resulting mismatch between vergence and accommodation leads to symptoms of asthenopia (eyestrain) and the inability to sustain activity, inadequate visual efficiency and information processing, and ultimately, causes adaptive changes in the visual system. Ocular symptoms of stress (general or ocular) may include blurred vision, double vision, eyelid myokymia or twitch, eyestrain or migraine headaches due to sensory overload of the brain, tired eye, irritation, redness and diplopia^{7,8,9}. Additionally, patients may exhibit variations in eye phoria, vergence

and accommodation⁴. There is a tendency for esophoria, orthophoria, or the less desired exophoria, to occur at near due to over-convergence⁴. Other signs include avoidance of near work and maintenance of a near working distance that is either exceptionally close or far.

Axial length is the distance between the anterior and posterior poles of the eye¹⁰. At birth it is approximately 17mm and measures approximately 24mm in adulthood. Variations occur in the range of some anatomical and physiological parameters of the eye¹¹. The eyes axial length could typically vary due to several factors such as refractive error, with it being longer than 24mm in myopia and shorter in hyperopia. It is the primary biometric determinant of refractive error. Thus any variation in this parameter could result to changes in refractive error causing blurred vision or eyestrain. The relative consistency of the eyes axial length among individuals and at different periods of the day has been questioned due to the influence of stress. This has formed the premise for this study.

METHOD

A prospective study was carried out at Madonna University Optometry Clinic. Fifty (50) subjects of both sexes and between the ages of 15-32 years were involved in the

study. Ethical clearance to carry out the study and also the consent of the subjects were obtained prior to the commencement of the study. Comprehensive ocular examination including visual acuity using Snellen chart, examination of the anterior segment using penlight and funduscopy using direct ophthalmoscope was carried out on the subjects and those of them with pathological conditions were eliminated.

Keratometry was carried out on all the 50 subjects to measure the radius of curvature of the cornea of each eye. The horizontal (K1) and vertical (K2) values of their keratometric reading were recorded. These readings were subsequently used to measure the axial length of the subjects through ultrasonography.

The axial length of the 50 subjects was measured through ultrasound using the A-SCAN ultrasound machine. This is a high frequency ultrasound machine which can be used to examine the ocular tissue and measure the axial length of the eyes. It uses reflected sound waves to measure the intraocular length of the eye. The ultrasound machine is set up and the patient is properly positioned and prepared for the procedure. The scan beam is passed through the eye and made to align correctly along the eyes visual axis. It strikes various ocular

interfaces or media with different densities and produces five tall spikes each representing the height of the cornea, anterior surface of the crystalline lens, posterior surface of the crystalline lens, the retina and the sclera. The axial length was measured one eye at a time. Two axial length measurements were taken same day for each of the subjects- one in the morning before they encountered any form of ocular stress. This was designated the axial length without stress. Another final axial length measurement was taken later in the evening after exposure to ocular stress by way of sustained near work such as long period of reading. This was designated the axial length after exposure to ocular stress. Data collected were presented in tables and analyzed using t-test statistics.

RESULTS

Fifty (50) subjects, 25% males and 25% females with mean age of 20.98 ± 3.65 years were screened. The age distribution of the subjects with sex is shown in table 1.

The mean axial length in the morning before exposure to ocular stress was 23.00mm in males and 23.22mm in females. In the evening after exposure to ocular stress, the mean axial length of males increased to 24.00mm (mean change of

+1.00mm) while that of the females shifted from the baseline mean of 23.22mm to 23.71mm indicating a mean change of +0.49mm (figure 1). The cumulative mean baseline axial length of the 50 subjects was 23.11mm while the mean induced value was 23.86mm showing an increase in axial length of +0.75mm after exposure to stress (Figure 2).

DISCUSSION

Majority of the subjects (48%) were aged between 15-20 years and there were equal proportions (25% each) of male and female subjects (table 1). This study recorded a variation between the mean axial length measured in the morning before the subjects were exposed to stress and that measured later in the evening of the same day after the subjects had been exposed to ocular stress. This is in consonance with a study which reported that human eyes undergo diurnal fluctuations in axial length with a pattern suggesting maximal axial length at midday due to stress¹². In males, the mean baseline axial length was 23.00mm and after exposure to stress a mean induced value of 24.00mm was recorded indicating an increase in axial length of +1.00mm due to exposure to stress (figure 1). The axial length of the female subjects increased from the mean baseline value of 23.22mm to a

mean induced value of 23.71mm representing a change in axial length of the magnitude of +0.49mm. This variation in axial length in response to stress was more in males (+1.00mm change) than females (+0.49mm change). Chakraborty et al¹¹ pointed out that diurnal variation of axial length occurs across a range of anatomical and physiological parameters of which sex may be one. This is in line with the findings of this study.

The cumulative mean baseline axial length of the 50 subjects was 23.11mm while the mean induced value was 23.86mm showing an increase in axial length of +0.75mm after exposure to stress. The impact of stress on axial length was statistically significant using the two sample student's t-test ($P < 0.05$). Stress of any kind can therefore bring about changes in the axial length of the eyeball causing it to elongate. This can occasionally give rise to

eyestrain^{5, 6}. According to Ward¹³ in situations of excessive stress, the eyes get longer as an adaptive mechanism to cope with such stress. This is in consonance with the findings of this study.

CONCLUSION

There is a strong correlation between ocular stress and axial length. Ocular stress can result in an elongation of the eyes axial length. Human eyes also undergo diurnal fluctuation in axial length with a pattern suggesting maximum axial length at midday due to exposure to stress.

Stress reduction procedures which involve relaxation should be practised frequently to reduce eyestrain, reduce the fluctuations in the eyes axial length and ensure visual clarity. Other studies should be carried out to determine more effective ways of preventing and managing ocular stress.

TABLES

Table 1: Age group and sex Cross tabulation

		Sex		Total
		Female	Male	
Age group	15-20	19	5	24(48%)
	21-26	4	19	23(46%)
	27-32	2	1	3(6%)
Total		25	25	50

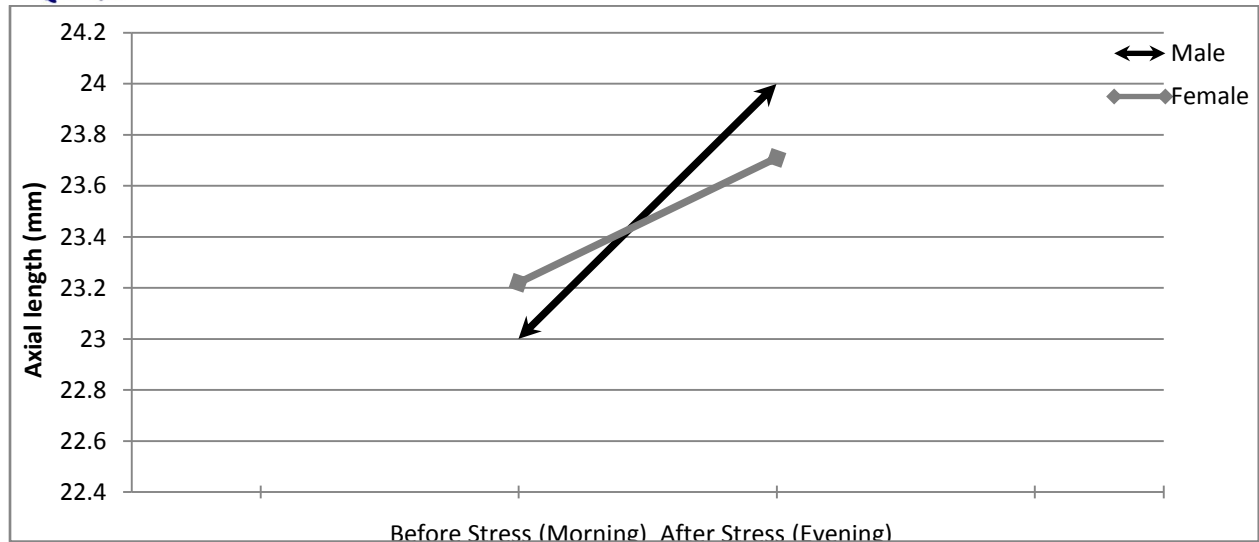


Fig 1: Mean axial length of male and female subjects before and after exposure to stress

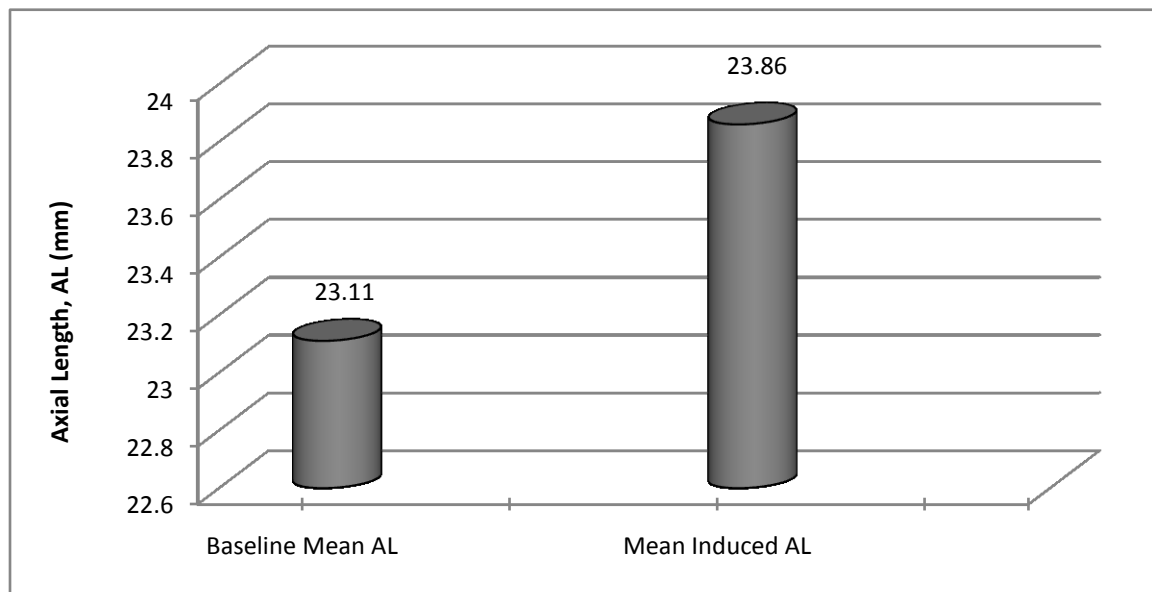


Fig 2: Cumulative baseline mean and mean induced axial length (AL) of all the subjects.

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