Research Article
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Relationship of posture, working distance and luminance with myopia among male population of religious rural schools of Pakistan

Abstract

Purpose: Aim of this study was to correlate head posture, working distance and luminance with Myopia.

Methods: 300 myopic aged 7 to 18 years (mean 13.5 years) without spectacles male students were included. The subjects under study were analysed through comprehensive examination (visual acuity, objective and subjective refraction). They were asked to recite Holy Book for ten minutes; a random picture was clicked and posture was measured by drawing neck angle at the picture. Their habitual maximum and minimum working distance was measured when student move backward and forward. Luminance level was recorded of each student at place where he used to study.

Results: Results of this study showed a negative correlation between myopia and posture reading ([95% CI] RE r= -0.07, p = 0.228, LE r= -0.079, p = 0.173) that depicts if angle decreases then myopia increases. A downhill and significant correlation was found between luminance level and myopia ([95% CI] RE r= -0.700, p = 0.000, LE -0.693, p = 0.000); as the lux (luminance) gets reduced the spherical equivalent gets increased and vice versa. There is a negative correlation between spherical equivalent and minimum working distance ([95% CI] RE r= -0.612, p = 0.000, LE r= -0.588, p = 0.000). A negative correlation between myopia and maximum working distance was found ([95% CI] RE r= -0.634, p = 0.000, LE r= -0.604, p = 0.000).

Conclusion: We concluded that variable working distance, adoption of abnormal head posture and low luminance in Religious Schools has noteworthy association with myopia. Eye care professionals should play their vital role to enlighten the community that while performing near tasks all these risk factors should be avoided to halt the progression of myopia.

Keywords: luminance, myopia, objective refraction, reid's line, subjective refraction, working distance

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Introduction

In current days, Myopia is a planetary problem. It is most prevalent in populated areas of East and Southeast Asia. There is a solid assumption that, in next 10 years myopia will influence 2.5 million people of the world. In accession of social and economic burden, myopia causes permanent visual impairment due to increase risk of retinal detachment, macular degeneration and glaucoma etc. Etiology of myopia is linked to the multiple factors in which environmental and genetic aspects play important role in progression of myopia.[1] Recently in Asia and western countries, school age myopia is most common. Onset of disease starts under the age of 8-14 years. It progress for next 10-15 years until refractive error become sustain. According to the most probable estimation; distance vision deterioration that occurs due to uncorrected myopia, influences person's performance of daily living activities, aesthetics, intellectual achievements and his mental makeup.[2] Reading for longer time period and with shorter reading distance is strongly associated with myopia. More important is that viewing TV at closer distance, writing with tilted head, work under luminance of fluorescent lamps and shorter nib-to-finger distance are responsible for axial elongation of eyeball. If nib to finger distance is shorter child tilt their head to write comfortably. Head tilt leads to more variations in dioptric stimuli, contraction of extraocular muscles and cause peripheral defocus on retina. All these factors are significantly associated with progression of myopia.[3] Axial elongation is promoted by mechanical forces generated during near work due to convergence and contraction of ciliary body. While performing near work eyes converge and accommodate to maintain binocular single vision on near target. When eyes converge, there is axial elongation of eyeball due to exertion of forces by extraocular muscles. Transient axial length change occurs when eyes accommodate. Phenomenon behind is the application of contraction forces by ciliary body or choroid. More ever it is also believed that ciliary body thickness might be larger in myopic eye and also vary between two eyes in anisomyopes.[4] Ambient light exposure has strong association with myopia. Increase exposure to sun light results in less growth of eyeball. Daily exposure to light levels more than 3000 lux per day (light level that typically encounter in outdoor) is related to reduction in increment of axial length of eyeball. Mechanism that control the growth of eyeball may sensitive to outdoor light intensity and intensity of bright light

of more than 3000 lux have greater influence on growth of eyeball.[5] Prevalence of myopia is also associated with lower vitamin D_3 level. Endogenous signal for synthesis of vitamin D_3 triggered when skin is exposed to sun light. Due to change in behaviour and increase indoor activities, there is limited sun exposure to skin leads to reduction in production of vitamin D_3 Outdoor activities provide opportunity to skin to be exposed to sun light which play important role in regression of myopia.[6] One Meta analysis provides evidence about non linear association between outdoor activities and progression of myopia. It is believed that outdoor activities for 76 minutes daily reduce the risk of myopia progression about 50%. Theory behind this deterioration of chances of being myopic due to increment outdoor activities is that; it promotes release of Dopamine and other hormones in body and especially in retina which helps in prevention of myopia.[7]

Measures that can be taken to slow down the progression of myopia are involved; spending less time on near work and more time on outdoor activities, having more open and suspicious living environment, and having fewer myopic parents.[8] In our study, we sought to find the relationship of myopia with parameters that are related to near work such as variable working distance, abnormal head posture while reading or performing near tasks and lighting condition at work place in male population of religious schools.

Methodology

This study was conducted in religious schools district Faisalabad Pakistan from November 2019 to April 2020. 300 myopic students without glasses were included in this study through purposive sampling after getting ethical approval from Research Committee of The University of Faisalabad and Religious Scholar of schools of Pakistan.Informed consent was taken before starting the data collection procedure and all tenets of Declaration of Helsinki were followed. Females (due to hormonal imbalance and not comfortable in taking pictures), those with Parental myopia, students with Spectacles any Systemic diseases affecting posture, Physician diagnosed muscle weakness, overweight/underweight, use of Systemic drugs such as antidepressants, supplements all were excluded. This study included history taking by a self-designed questionnaire. Subject's fundus examination was done with ophthalmoscope and the students without any ocular and systemic pathology were included in our study. Visual acuity was taken with log MAR visual acuity chart, objective refraction was done with retinoscope and subjective refraction was performed in order to find out amount of refractive error. Working distance of each subject was measured while reciting the Holy Quran with tape measure as when he moved away from reading material maximum working distance was measured and when moved towards the reading material minimum working distance was measured. Every student was given 10 minutes to recite the Holy Quran and after that Posture assessment was done by clicking the picture of subject. After taking print of that picture on A4 paper, we drawn Horizontal line (line passes from centre of ear and outer canthus of eye) and Reid's line (line passes from inferior meatus to outer canthus) with scale on paper and angle formed between these two lines after their intersection at outer canthus was measured. This angle was mentioned as neck angle which is easy to measure and most relatable to eyes and neck position while reading. Illumination present in the room where students recite the Holy Quran was measured with the help of photometer (Figures 1–3). The measurements obtained binocularly from each subject were expressed as mean ±standard deviation by applying Descriptive Statistics. The analysis was done by entering whole data into the SPSS software version 25. Measurements were correlated with tabulation and graphs (bar graph, scatter plot graph).

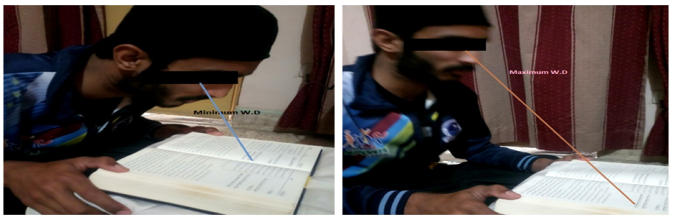

Figure 1 Showing the measurement of Maximum and Minimum working distance while recitation of Holly Quran.

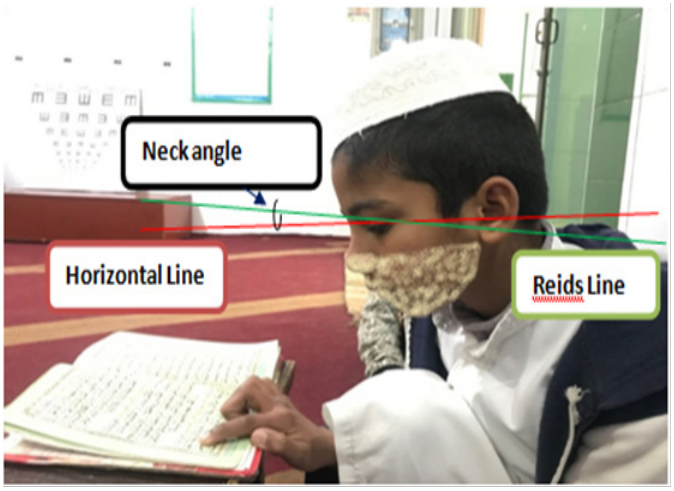

Figure 2 Showing relationship of Reid's line and Horizontal line for measurement of neck angle.

Figure 3 Different Luminance level at different religious schools.

Results

Our study included 600 eyes of 300 male students of religious schools having myopic refractive error with age ranged between 7-18 years. Out of 300 students; 8.3% students were 7-10 years old, 60.7% were 11-14 years old and 31% were 14-18 years old. Mean visual acuity for right eye (RE) was 0.405 LogMAR±0.34 and for left eye (LE) was 0.416 LogMAR±0.35. Mean Spherical Equivalent (SE) for right eye was 1.345D±1.07 and for left eye was 1.375D±1.10. Mean Neck Angle was 10.84°±5.54. Mean Luminance was 49.80 lux ±22.96. Mean Minimum Working Distance (WD) was 23.363cm±9.73. Mean Maximum Working Distance was38.413cm±11.87. There was a difference among visual acuity of both eyes. Likewise, there was a difference between Spherical Equivalent of both eyes. This difference revealed the presence of anisometropic refractive error among the students. Be noted that; there were deterioration of visual acuity more in left eye then in right eye, which was elucidated by the adoption of abnormal head postures by students while reading. Head posture that student adopted while reading and Myopia had weak negative

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correlation (r = -0.07) (Table 1) for right eye and (r = -0.079) (Table 2) for left eye. This negative correlation showed that if Neck angle decreases (abnormal head posture) then there will be increment in Myopia. Subjects, who tilt their head more, had high degree of refractive error. More head tilt leads to poor vision. Bending the head at smaller angle was associated with progression of myopia.

Lighting condition under which Madaris students read Holy Quran and Myopia had strong negative correlation (r = -0.700) (Table 3) for right eye and (r = -0.693) (Table 4) for left eye. Results are highly significant as ($p < 0.05$). Lighting condition for each student was estimated exclusively for each student. This negative correlation exposed that decreased Luminance level was associated with increase in S.E. As Luminance decreases then it will lead to increase in amount of refractive error. Subject works under good luminance had better vision as compare to those who work under poor lighting condition. Drop in lighting level while reading, was significantly associated with progression of Myopia.

Table 1 Relationship of posture with Myopia in right eye

Correlation		Spherical equivalent of right eye	Neck angle
Spherical Equivalent of Right Eye	Pearson Correlation No of Students(N) Sig.(2-tailed)	1 300	-0.07 300 0.228
Neck Angle	Pearson Correlation No of Students(N) Sig.(2-tailed)	-0.07 300 0.228	1 300

Table 2 Relationship of posture with Myopia in left eye

Correlation		Spherical equivalent of left eye	Neck angle
Spherical Equivalent of Left Eye	Pearson Correlation No of Students(N) Sig.(2-tailed)	1 300	-0.079 300 0.173
Neck Angle	Pearson Correlation No of Students(N) Sig.(2-tailed)	-0.079 300 0.173	1 300

Table 3 Relationship of Luminance with Myopia in Right Eye

Correlation		Spherical Equivalent of Right Eye	Luminance
Spherical Equivalent of Right Eye	Pearson Correlation No of Students(N) Sig.(2-tailed)	1 300	-0.700 300 0.000
Luminance	Pearson Correlation No of Students(N) Sig.(2-tailed)	-0.700 300 0.000	1 300

Table 4 Relationship of luminance with myopia in left eye

Correlation		Spherical equivalent of left eye	Luminance
Spherical Equivalent of Left Eye	Pearson Correlation No of Students(N) Sig.(2-tailed)	1 300	-0.693 300 0.000
Luminance	Pearson Correlation No of Students(N) Sig.(2-tailed)	-0.693 300 0.000	1 300

Minimum working distance (distance of subject to reading material when subject is close to the reading material) and Myopia had strong negative correlation (r = -0.612) (Table 5) for right eye and (r = -0.588) (Table 6) for left eye. Results are highly significant as ($p < 0.05$). This negative correlation showed that decreased subject's minimum reading distance had associated with increased amount of refractive error. Accomplishment of near tasks at shorter reading distance had strongly related to progression of myopia. Maximum working distance (distance of subject from reading material when subject is at farther distance from reading material) and Myopia had strong negative correlation (r = -0.634) (Table 7) for right eye and (r = -0.604) (Table 8). Results are highly significant as ($p < 0.05$). This negative correlation showed that reduction in maximum reading distance had strong relationship with increased in amount of refractive error. Students those read at shorter reading distance had high degree of Myopia.

Table 5 Relationship of minimum working distance with myopia in right eye

Correlation		Spherical equivalent of right eye	Minimum working distance
Spherical Equivalent of Right Eye	Pearson Correlation No of Students(N) Sig (2-tailed)	1 300	-0.612 300 0.000
Minimum Working Distance	Pearson Correlation No of Students(N) Sig (2-tailed)	-0.612 300 0.000	1 300

Table 6 Relationship of minimum working distance with myopia in left eye

Correlation		Spherical equivalent of left eye	Minimum working distance
Spherical Equivalent of Left Eye	Pearson Correlation No of Students(N) Sig (2-tailed)	1 300	-0.588 300 0.000
Minimum Working Distance	Pearson Correlation No of Students(N) Sig (2-tailed)	-0.588 300 0.000	1 300

Table 7 Relationship of maximum working distance with myopia in right eye

Correlation		Spherical equivalent of right eye	Maximum working distance
Spherical Equivalent of Right Eye	Pearson Correlation No of Students(N) Sig (2-tailed)	1 300	-0.634 300 0.000
Maximum Working Distance	Pearson Correlation No of Students(N) Sig (2-tailed)	-0.634 300 0.000	1 300

Table 8 Relationship of maximum working distance with myopia in left eye

Correlation		Spherical equivalent of left eye	Maximum working distance
Spherical Equivalent of Left Eye	Pearson Correlation No of Students(N) Sig (2-tailed)	1 300	-0.604 300 0.00
Maximum Working Distance	Pearson Correlation No of Students(N) Sig (2-tailed)	-0.604 300 0.000	1 300

Discussion

Posture, Luminance and Working Distance are important factors contributing for myopia progression. In present research, main objective was to find relationship of posture, luminance and working distance with myopia development. World Health Organization vision 2020 'Right to Sight' is aimed at the prevention and control of blindness especially in children. We select Religious schools for our study because myopia prevalence is very high in this community. Parents admit their children in schools at very early age; when the process of emmetropization has not been completed. They used to study over there for whole day with minimal outdoor exposure. In a very congested area a large number of students study for several hours. While reciting Holy Quran they continuously move their head briskly forward and backward which in result cause the defocusing of image on retina. For clear view they adopt abnormal head posture and bend their head according to their comfortable level. We measure neck angle by drawing Reid's line (neck angle) at the page because it was a facile way. As our study was aimed at measuring the working distance and neck angle of students in their formal reading positions so that's why an electric tracking appliance was unable to delineate all of these factors at the same time. The illumination level at the place of study was very low.

Parssinen and Kauppinen study revealed that myopia was highly associated with eyes turned more downward. The downward gaze angle was strongly associated with myopia progression (r = -0.166, p = 0.028).[9] Our study also found a negative correlation of myopia and neck angle adopted for reading (RE r= -0.07, p = 0.228, LE r= -0.079, p = 0.173). It concluded that posture while reading adopted is inversely proportional to myopia. A decline in neck angle causes an incline in myopia. A study concluded that the mean SE was highly myopic in those who spent longer time in continuous reading (P= 0.009), head tilt while writing (P=0.004), use of fluorescent desk lights (P<0.001) and closer reading distance (P=0.0002).[3] Similarly our study also manifests a negative correlation between posture while reading and SE. There was a significant bleak correlation found between luminance and SE (RE r= -0.700, p = 0.000, LE -0.693, p = 0.000). This means that luminance level is inversely proportional to myopia; a decrease in lux (luminance) causes the increment of myopia. W Neil Charman inferred that during long term reading and writing tasks children adopt posture according to their comfortable

level and eye closer to reading/writing object get more Dioptric stimuli. The peripheral retina remains out of focus and in turn leads to form-deprivational myopia.[10] Similarly we perceive that the students of Religious Schools use variable reading distance and fast movement of head that cause defocusing of image on retina; due to which they adopt posture according to their comfort which results in myopia.

Alike; our results also manifest a significant downhill correlation between variable working distance (maximum and minimum working distance) and myopia. As the students gets closer to Holy Quran for reading; distance gets reduced and myopia gets aggravate. Change in working distance and continuous reading for long hours; subjects under study adopt bad posture due to which one eye gets closer to Quran and one at distance which is the leading cause of anisometropia in this population.

Conclusion

We concluded that abnormal posture during study and continuous change of reading distance has a significant relationship with myopia development. Low luminance level is the proceeding factor for deterioration of naked vision. Hence the results of our study fulfil our objectives that posture, working distance and luminance has relationship with myopia.

Recommendations

This research was conducted to a cross sectional designed to open the way for further research to be conducted in this subject for the future. The major reason behind increasing myopia in Madaris was that the children under 7 years got admission in Hifz e Quran. Before 7 years of age process of emmetropization is incomplete that results in myopia development. So parents should be guided not to admit their children in Madaris under 7 years of age. Eye care specialists should play their vital role to direct the community to study in proper luminance and increase the outdoor time. Guide parents to check the posture and working distance of their children while they doing near tasks.

Limitations

Study was limited to one time point. Age group was limited to 7-18 years to eliminate other predominant factors. Only male population was under study. Progression was not analyzed and only one point time data was collected. A cohort study would be more reliable. This study should be done at both corrected and un-corrected refraction and compare the both.

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Conflicts of interest

Authors declares that there is no conflict of interest.

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