Development of Myopia in Medical School

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Aim: *To determine the effect of extensive educational effort involving near work on the progression and emergence of new cases of myopia in medical students.*
Patients and Methods: *This longitudinal study was performed on 262 eyes of 131 randomly selected first-year medical students attending Isfahan University, Isfahan, Iran. Eye examinations, including objective and subjective refraction, were performed at the time of study enrolment and again after 5.5 years. Eyes with ≥0.25 D spherical equivalent myopic error were considered to be myopic. Data from the initial and follow-up examinations were compared and analysed using Student's t test and chi-squared test.*
Results: *The prevalence of myopia increased from 46.5% to 64.0% during the study period. The mean myopic progression was 0.20 D per year. Myopic development occurred in 52.5% of the participants.*
Conclusion: *Medical students are at risk for myopic development in medical school. This should be taken into account for prognostic purposes and in relation to refractive surgery.*

Key words: *Disease progression, Iran, Longitudinal studies, Medical students, Myopia*

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Introduction

The prevalence of myopia has been found to vary from 16% to 70% in different ethnic populations, with a higher prevalence in Asian countries such as Taiwan, Singapore, Japan, Hong Kong, and China. The reasons for these differences are of interest.[1] It has been suggested that parental history and genetic inheritance play a role in the development of myopia.[2-5] In addition, the visual environment has been shown to affect the growth of the eye in animal models of myopia.[6] Myopic progression in juvenile-onset myopia usually stops in the mid-teen years and refractive errors stabilise in 75% of teenagers.[2] Some studies indicate an association between extensive education-related near-work activity and high prevalence of myopia,[7-10] and recent studies provide clear evidence that environmental factors and ethnic differences can affect myopic progression.[11-13]

The effect of working habits on myopic progression in different populations and ethnic groups needs further clarification. There have been few previous longitudinal studies of myopic progression in young adults undertaking higher education.[14-16] This study was performed at the Eye Department, Farabi Hospital, Isfahan University, Isfahan, Iran, from 1998 to 2003 to determine the incidence and progression of myopia in young adult medical students attending Isfahan University.

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Patients and Methods

From 300 first-year medical students who enrolled at Isfahan University in 1998, 150 were randomly selected to participate in this longitudinal study. The purpose of the study was discussed with each participant and personal and ocular history was collected, including the age of onset of myopia and any history of eye surgery or trauma. The study process was consented to by all of the selected participants and ethical approval was obtained. Participants were requested to stop wearing soft contact lenses for 7 days prior to each eye examination.

Measurement of refractive error included cycloplegic autorefractometry (Topcon RMA8000; Topcon Corporation, Tokyo, Japan) and retinoscopy (Heine Optotechnik, Herrsching, Germany) and subjective refraction using a Snellen chart and trial lenses to check the uncorrected and best corrected visual acuity of each eye. Tropicamide 1% was used for cycloplegic refraction. Two of the authors performed the eye examinations. The entire eye examination procedure, including measurement of refractive error, was repeated 5.5 years later, when the students were in the sixth year of their medical course. Eyes with a spherical equivalent myopic error of ≥0.25 D were considered to be myopic and progression of myopia was defined as a myopic shift of ≥0.37 D between the first and second examination. Of the 150 participants enrolled, 131 (262 eyes) remained in the study. Seventeen were excluded due to loss to follow-up and 2 because of refractive surgery and irregular astigmatism. Data collected at the initial

Table 1. Myopic status of medical students at time of enrolment.

Myopic status (D)	No. of eyes (%)
None	140 (53.5)
Low (0.25 to 3.00)	88 (33.5)
Moderate (>3.00 to 6.00)	30 (11.5)
High (>6.00 to 8.00)	4 (1.5)
Pathologic myopia	0
Total	262 (100)

and follow-up examination were compared and analysed using Student's *t* test and chi-squared test.

Results

The ages of the 84 male and 47 female students who completed the study ranged from 17 to 25 years (mean, 19.8 years; SD, 1.2 years) at the start of the study. The prevalence of myopia increased significantly from 46.5% to 64.0% ($p < 0.001$); the mean initial myopic error was 1.97 D (SD, 1.86 D; range, 0.25 to 7.25 D) and the mean final myopic error was 2.98 D (SD, 2.13 D; range, 0.25 to 9.00 D). Of the 122 eyes that were myopic at the beginning of the study, 65% had juvenile-onset myopia (onset at 7 to 16 years) and 35% became myopic after the age of 16 years. The myopic status of the students at the beginning of the study is given in Table 1.

A high proportion of eyes that were myopic at the beginning of the study (81%) showed myopic progression during the study period (Table 2), with an average myopic shift of 1.13 D (SD, 0.81 D; range, 0.37 to 4.38 D). In addition, 33% of eyes that were not myopic at the beginning of the study became myopic during the study period (adult-onset myopia) [Table 2]. For the latter eyes, the mean myopic shift was 1.05 D (SD, 0.78 D; range, 0.25 to 4.25 D) and most showed a myopic shift of 0.37 to 4.25 D (Table 2). Overall, 52.5% of participants showed myopic progression or onset of myopia while attending medical school. The diopter extent of myopic shift in relation to initial myopic error is shown in Table 3. Statistical significance was observed only between groups 1 and 3 in the left eye ($p = 0.005$). No statistically significant difference was found between men and women with respect to myopic progression or the incidence of adult-onset myopia. No statistically significant difference was found overall between the right and the left eyes in terms of the proportion of eyes that showed myopic development and the extent of myopic shift.

Discussion

Most students who were myopic when enrolled in medical school had late juvenile and early adult-onset myopia. The age of onset was >14 years in 81% of participants, most of whom experienced myopic progression while attending medical school. Approximately one-third of the students who were not myopic at the time of enrolment became myopic while at medical school. The results of the present study differ from those reported for juvenile-onset myopia in the general population, which indicate that juvenile-onset myopia usually stops in the mid-teen years and that stabilisation of refractive errors occurs in 75% of teenagers.[2] However, the results of the present study are comparable to the results of 3 previous longitudinal studies of similar groups experiencing high educational demands (Table 4),[14-16] confirming the influence of near-work activity on adult myopic development. In comparison with the present study, Lin et al, in a study of medical students in Taiwan, found a higher prevalence of myopia (92.8%) and a higher

Table 2. Frequency distribution of myopic progression in young adults during attendance at medical school.

Initial status	Right eye		Left eye	
	Myopic shift (D)	No. of eyes (%)*	Myopic shift (D)	No. of eyes (%)*
Myopia, ≥0.25 D	>2.00 to 4.38	7 (2.67)	>2.00 to 3.50	6 (2.29)
	>1.50 to 2.00	6 (2.29)	>1.50 to 2.00	10 (3.81)
	>1.00 to 1.50	18 (6.87)	>1.00 to 1.50	11 (4.19)
	>0.75 to 1.00	7 (2.67)	>0.75 to 1.00	8 (3.05)
	>0.50 to 0.75	7 (2.67)	>0.50 to 0.75	6 (2.29)
	0.37 to 0.50	7 (2.67)	0.37 to 0.50	6 (2.29)
	0.25	5 (1.90)	0.25	6 (2.29)
	0.00	5 (1.90)	0.00	7 (2.67)
Total	—	62 (23.64)	—	60 (22.88)
No myopia, <0.25 D	>2.00 to 4.25	4 (1.52)	>2.00 to 2.25	2 (0.76)
	>1.50 to 2.00	1 (0.38)	>1.50 to 2.00	4 (1.52)
	>1.00 to 1.50	2 (0.76)	>1.00 to 1.50	3 (1.14)
	>0.75 to 1.00	4 (1.52)	>0.75 to 1.00	2 (0.76)
	>0.50 to 0.75	3 (1.14)	>0.50 to 0.75	3 (1.14)
	0.37 to 0.50	5 (1.90)	0.37 to 0.50	6 (2.29)
	0.25	4 (1.52)	0.25	3 (1.14)
	0.00	46 (17.55)	0.00	48 (18.32)
Total	—	69 (26.33)	—	71 (27.09)

* Expressed as a percentage of total number of left and right eyes.

Table 3. Comparison of myopic progression in students grouped according to myopic error at time of enrolment.

Group	Initial myopic error (D)	No. of eyes (right)	Mean (D)	SD	No. of eyes (left)	Mean (D)	SD
1	≤0.50	23	0.9783	0.7976	13	0.5769*	0.5138
2	0.75-2.75	21	1.2329	1.0339	29	1.2078	0.9511
3	≥3.00	18	1.2783	0.7611	18	1.2708*	0.7367
Total	≥0.25	62	1.1317	0.8716	60	1.0900	0.8451

* $p < 0.005$.

Table 4. Comparison of results of longitudinal studies of adult myopic development.

Authors	Myopic progression (D/year)	Incidence of adult-onset myopia (%)	Study population	Age (years) Mean (SD)	Follow-up (years)
Kinge et al[14]	0.17	59	196 engineering students	20.6 (1.1)	3.0
Lin et al[15]	0.12	42	345 medical students	19.8 (1.2)	5.0
McBrien and Adams[16]	0.38	39	166 clinical microscopists	Range: 21-63	2.0
Present study	0.20	31	131 medical students	19.8 (1.2)	5.5

initial mean myopic error (4.26 D; SD, 2.66 D) but a lower mean rate of myopic progression (0.12 D per year).[15]

The effect of confounding factors on the results of the present study is likely to be low because no clear effect of heredity has been found for juvenile- and adult-onset myopia and the study population was relatively homogenous with respect to age, race, education, intelligence, and diet. Most of the myopic students had low to moderate myopia, there were only 2 students with high myopia, and none showed pathologic fundus changes. Astigmatism was present in 40% of eyes (mean, 0.60 D; SD, 0.60 D; range, 0.50 to 3.25 D) and 75% of occurrences were of the with-the-rule type. No other genetic predisposition such as glaucoma, ocular hypertension, cataract, lens subluxation, retinal detachment, esodeviation, or history of premature birth was found in the study population. The results of the study are probably not significantly affected by the loss of 12.5% of participants to follow-up because this group did not differ significantly from the rest of the study population in terms of initial refractive error.

The rate of anisomyopia of ≥0.50 D was 8.4% among students with myopia at the start of the study; this rate was found to be 16.8% at the end of the study ($p = 0.001$). A tendency for further progression in right eyes was observed in these asymmetrically progressed myopic cases. Comparable studies of groups of young adults of similar ethnicity who were engaged in minimal near work activity would help to define further the effect of near work on myopic development. Stepwise longitudinal studies would be useful for determining the extent of myopic development due to near work at different ages.

The findings of this study confirm the association between intense near work activity and the development of myopia. They also indicate that about 50% of students in medical school are at risk for myopic onset or progression. This should be taken into account for prognostic purposes and in relation to refractive surgery.

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