

Pupil size in Jewish theological seminary students

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PURPOSE. *To investigate the authors' clinical impression that pupil size among myopic Jewish theological seminary students is different from pupil size of similar secular subjects.*

METHODS. *This cross-sectional study was conducted on 28 male Jewish theological seminary students and 28 secular students or workers who were matched for age and refraction. All participants were consecutively enrolled. Scotopic and photopic pupil size was measured by means of a Colvard pupillometer. Comparisons of various parameters between the groups were performed using the two-sample t-test, Fisher exact test, a paired-sample t-test, a two-way analysis of variance, and Pearson correlation coefficients as appropriate.*

RESULTS. *The two groups were statistically matched for age, refraction, and visual acuity. The seminary students were undercorrected by an average of 2.35 diopters (D), while the secular subjects were undercorrected by only 0.65 D ($p < 0.01$). The average pupil size was larger in the religious group under both scotopic and photopic luminance. This difference was maintained when the two groups were compared according to iris color under both conditions, reaching a level of statistical significance ($p < 0.0001$). There was a significant difference in photopic pupil size between dark and light irises ($p = 0.049$), but this difference was not maintained under scotopic conditions.*

CONCLUSIONS. *The average pupil size of young ultraorthodox seminary students was significantly larger than that of matched secular subjects. Whether this is the result of intensive close-up work or of apparently characteristic undercorrection of the myopia is undetermined. (Eur J Ophthalmol 2004; 14: 206-10)*

KEY WORDS. *Iris color, Pupil size, Secular students, Ultra orthodox seminary students*

Accepted: February 19, 2004

INTRODUCTION

Under normal conditions, the pupil of the eye controls retina illumination, determines retinal image quality (1, 2), improves image quality on the retina by increasing the depth of focus of the eye, and re-

duces the degree of chromatic and spherical aberration (35). The diameter of the normal pupil varies from 2 to 9 mm, depending on ambient illumination, emotional state, fatigue, and amount of close-up effort (6). The influence of refraction on pupil size and whether persistent unfavorable reading conditions

affect pupil size are unresolved issues.

Pupil size is an important factor in patient satisfaction after refractive surgery. Under scotopic conditions, patients with large pupils are at high risk of night vision difficulties, such as halo, glare, starbursts, and monocular diplopia (710). It was our impression that the pupils of ultra-orthodox Jewish theological seminary students who presented at our clinic for refractive surgery were larger than those of our other patients. The current prospective study was designed to investigate pupil diameters in a population of myopic seminary students and myopic secular men in an effort to enhance our understanding of a possible correlation between pupil size and habitual behavior patterns.

METHODS

A total of 112 eyes of 56 consecutive myopic men who were being evaluated for refractive surgery were studied. All the participants were apparently in good health and free of eye pathology. None of them were taking systemic or ocular medications and none were smokers. The subjects were divided into two groups: ultra orthodox Jewish seminary students, who characteristically devote approximately 16 hours a day to their studies, and secular men, who were either students in regular schools or employed in various jobs.

All the study participants underwent a full ophthalmic examination in preparation for refractive surgery, including best-corrected visual acuity (BCVA), cycloplegic refraction, Goldmann applanation tonometry, slit-lamp examination, funduscopy, corneal topography, and ultrasonic pachymetry. A photometer was used to measure luminance intensities in room light (photopic, 5 candelas/m²) and dark-adapting (scotopic, 1 candelas/m²) conditions. All pupillary measurements were made using a Colvard pupillometer (Oasis Medical, CA) under both lighting conditions.

Statistical analysis

Comparisons between the seminary and secular patients were performed using the two-sample t-test for continuous variables and Fisher exact test for categorical parameters. Photopic and scotopic pupil sizes were compared by means of a paired-sample

t-test. A two-way analysis of variance (patient group and iris color) with age as covariate was performed to evaluate the effect of studying in a seminary and of iris color, adjusted to age, on pupil size. Pearson correlation coefficients were calculated between pupil size and age, refraction and visual acuity. All data were presented as an average of two eyes. SPSS for Windows was used for statistical analysis.

RESULTS

There was no significant difference in age, refraction, or visual acuity between the two groups. The BCVA was 6/6.5±0.72 in the secular group and 6/7.03±1.05 in the seminary group. The mean refraction was -8.68±2.08 diopters (D) in the secular group and -8.89±2.49 D in the seminary group. Notably, the seminary group was undercorrected at the presenting examination by an average of 2.35±1.05 D, while the secular group was undercorrected by only 0.65±0.4 D ($p<0.01$).

Half of the men in the secular group had light iris color (blue and green) while 16 (57.1%) of the men in the seminary group had light irises. The mean scotopic pupil diameter was 5.46±0.47 mm in the former group compared to 6.56±0.39 mm in the latter. Scotopic luminance examinations revealed that the light eyes in the seminary group had a pupil diameter of 6.66±0.35 mm, while the average pupil diameter in the secular group was 5.75±0.43 mm. Similarly, in dark eyes, the average pupil diameter in the seminary group was 6.50±0.43 mm, compared to 5.18±0.32 mm in the secular group. The mean photopic pupil size in the seminary group was 4.41±0.53 mm, compared to 3.48±0.5 mm in the secular group. When comparing pupil size according to eye color under photopic conditions, the light-eyed seminary group had a 4.63±0.47 mm pupil compared to 3.79±0.47 mm in the secular group, while the dark-eyed seminary group had a 4.13±0.48 mm pupil diameter compared to 3.18±0.32 mm in the dark-eyed secular group. Thus, the differences in scotopic and photopic pupil size between the seminary and secular group were statistically significant whether the eyes were light- or dark-colored, with the larger pupil being found in the seminary group.

There was a significant difference in photopic pupil size between dark and light irises ($p=0.049$), but there

TABLE I - COMPARISON BETWEEN JEWISH THEOLOGICAL SEMINARY AND SECULAR PATIENTS (univariate analysis)

Characteristics	Secular (n=28)	Religious (n=28)	p Value
Age, yr, mean±SD	33.5±9	34.1±9	0.8
Visual acuity	6/6.5	6/7	0.03
Refraction, D, mean±SD	-8.7±2.1	-8.9±2.4	0.73
Pupil size, scotopic, mm, mean±SD	5.46±0.5	6.59±0.4	<0.0001
Pupil size, photopic, mm, mean±SD	3.48±0.5	4.41±0.5	<0.0001
Iris color, n (%)			
Light	14 (50)	16 (57)	
Dark	14 (50)	12 (43)	0.8

was no significant difference between them in scotopic pupil size. A significant interaction between group and iris color was noted only in scotopic pupil size, with the light iris significantly larger than the dark iris in the secular group, but not in the seminary group (0.57 mm versus 0.16 mm, respectively). The disparity between scotopic and photopic pupil size was significantly larger in the seminary group compared with the secular group (2.18±0.4 mm versus 1.98±0.3 mm, p=0.033). No other parameter was associated with this disparity (Tab. I and II). Age was significantly inversely associated with photopic pupil size in both groups (r=-0.377, p=0.004).

DISCUSSION

The size of the normal pupil is influenced by the intensity of retinal illumination, age, iris color, proximity of the stimulus, and emotional state of the individual (3, 11). The influence of refraction on pupil size remains a matter of controversy (12). Woung et al showed that myopes had smaller pupils than emmetropes after dark adaptation (12).

We are keenly aware that pupil size is an important factor in patient satisfaction following refractive surgery. Over the past few years, it was our growing impression that ultra-orthodox Jewish seminary students who came to our clinic for refractive surgery had larger pupils and needed a larger optical treatment zone than the rest of our patient population. This prospective study confirmed our observation: the seminary students' average pupil size was 1 mm larger in both scotopic and photopic conditions than the pupils of men who were matched for age, refraction, and iris color.

TABLE II - SUMMARY OF ANALYSIS OF VARIANCE FOR PUPIL SIZE ACCORDING TO PATIENT GROUP, IRIS COLOR, AND AGE

Effect	Scotopic	Photopic	Difference
Group	<0.0001	<0.0001	0.033
Iris color	0.101	0.049	0.52
Group color	0.056	0.739	0.098
Age	0.254	0.064	0.3

Traditionally, ultra orthodox Jewish schooling begins at age 4 and continues throughout adult life in an academy of religious learning (a yeshiva). The primary emphasis is on Jewish religious texts such as the Bible, Talmud, and religious legal codes. The school day is 4 hours long for 4-year-olds, and reaches 16 hours of intensive study from teenage years and throughout adult life. Studies are often characterized by the use of lecterns while seated, which brings the text to within 20 cm of the eyes. The text itself is composed of various sizes of print on the same page, often as small as 4 points, and not always of good contrast. Learning is traditionally accompanied by swaying back and forth, a behavior that can lead to a constant varying of focal distance between 20 and 50 cm.

Various theories of myopia progression have been proposed. It is almost certainly related to close-up work in genetically predisposed individuals, as had been shown in Israeli studies of men in general (13) and of Jewish seminary students in particular (only myopathy was studied versus pupil size and color of the iris) (14, 15). Because the seminary student spends most of the day studying texts and does not usually drive a car or watch television, it has been

Fig. 1 - Pupil size in secular and Jewish theological seminary patients by iris color (scotopic).

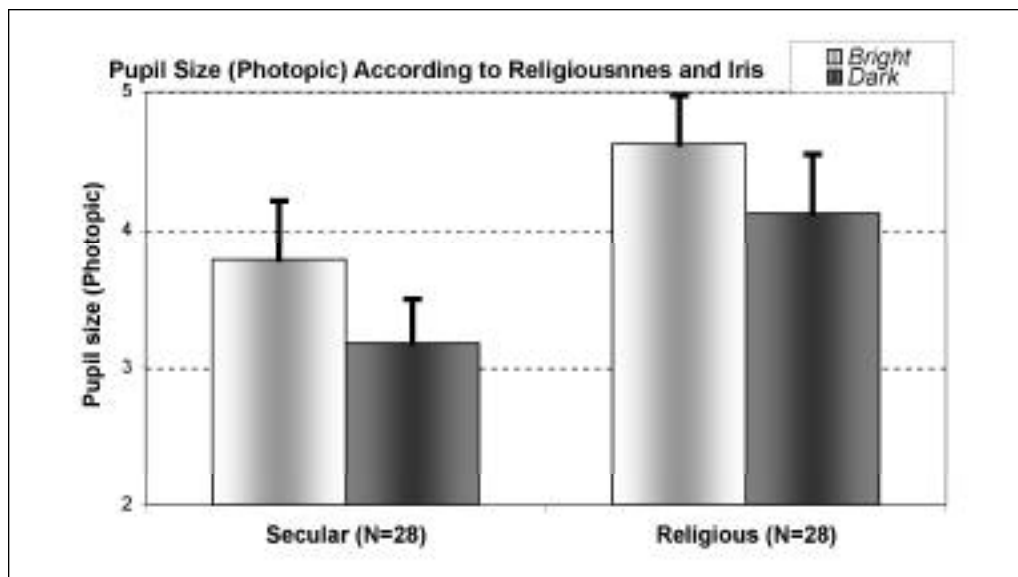
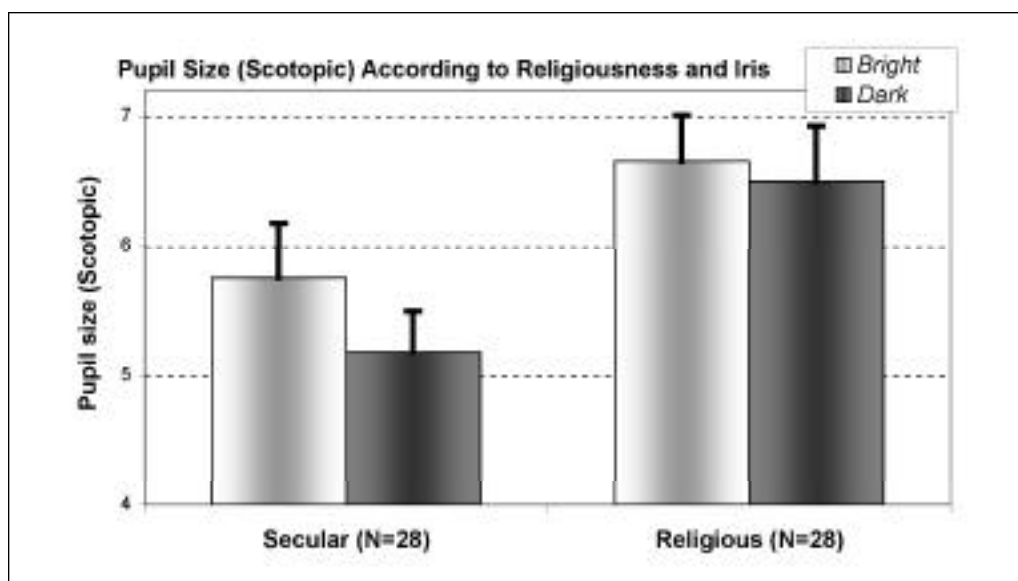


Fig. 2 - Pupil size in secular and Jewish theological seminary patients by iris color (photopic).



customary to undercorrect the myopia by 1 to 3 D. This practice was supported by the theory that the use of reading glasses for extended close-up work could help slow the progression of the myopia. In our current study, the seminary students had an average undercorrection of 2.35 D, significantly more than the undercorrection of only 0.65 D in the secular group.

We have no definitive explanation for the increased pupil size we found in seminary students compared

to secular controls. Accommodation, as part of the near reflex, also induces miosis through parasympathetic mechanisms. It may be that repeated stimulation of the near reflex can cause chronic changes in the pupil size. This effect, however, was not present in our seminary students who, due to the undercorrection of their myopia, habitually underaccommodate. It could be that the chronic lack of use of the near reflex may lead to a less contracted sphincter muscle and, therefore, a larger pupil.

ACKNOWLEDGEMENTS

The authors thank Esther Eshkol, MA, the medical and scientific copyeditor of Tel Aviv Sourasky Medical Center, for editorial assistance.

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