Original Article

# Frequency of Myopia and Its Associated Risk Factors Among Madrassa Students in Pakistan

PJO – Official Journal of Ophthalmological Society of Pakistan



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## ABSTRACT

**Purpose:** To determine frequency of myopia and its associated risk factors among madrassa students in Pakistan.

**Study Design:** Descriptive observational.

**Place and Duration of Study:** The study was conducted at the Pakistan Institute of Community Ophthalmology, Hayatabad Medical Complex, Peshawar, from January 2023 to June 2023.

**Methods:** Using the two-stage sampling technique, this cross-sectional study was conducted on 1750 students aged 6–18 years. In stage 1, by the probability proportionate to size method, 43 strata were identified. In the second stage, 44 students from each stratum were identified by a simple random sampling method. A detailed eye examination was performed by trained optometrists. Logistic regression was applied to investigate the association of myopia with outdoor activity, the distance between eyes and books, sleep duration, use of electronic gadgets, and study hours.

**Results:** A total of 1750 madrassa students, including 1256 (71.8%) male, were examined. Vision impairment (6/18 > VA < 6/60) was present in 14.2%. Myopia was the most common refractive error, contributing to 11.1%. The prevalence of myopia was high in female (12.8%) but not statistically significant (p = 0.096). Myopia increases with increasing age (p<0.01). The distance between eyes and book (OR=.354; 95%CI.216 to.579), sleep duration (OR=1.957; 95%CI 1.349 to 2.839), continuous use of electronic gadgets (OR=.492; 95%CI.379 to.638), and study hours in the madrassa (OR=.404; 95% CI.290 to.563) were significantly associated with myopia.

**Conclusion:** Myopia is the most common refractive error in Madrassa students. Near working distance, sleep duration, continuous use of electronic gadgets, and study duration were the risk factors for myopia.

**Keywords:** Myopia, Refractive error, Blindness, Cycloplegia, Refraction.

**How to Cite this Article:** Khan S, Shah M, Jan S, Hassan J, Atif Ullah. Frequency of Myopia and its Associated Risk Factors among Madrassa Students in Pakistan. 2025;41(3):281-287. **Doi:** 10.36351/pjo.v41i3.1944

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*Received: September 26, 2024*
*Revised: March 14, 2025*
*Accepted: April 24, 2025*

## INTRODUCTION

Refractive errors, such as myopia, hyperopia, and astigmatism are common visual disorders causing blurriness of vision that significantly affect school going children. These conditions can impair vision and, consequently, impact academic performance, social interactions, and overall well-being. Higher myopia has vision-threatening complications such as retinal detachment, myopic macular degeneration, cataracts, and glaucoma.[1] Myopic macular degeneration is the leading cause of blindness and visual impairment in some parts of Asia.[2] The risk of posterior staphyloma also increases in high myopia.[3]

Recent studies indicate that the prevalence of refractive errors in children is rising globally.[4] Approximately 20% of children aged 6 to 12 years in Europe and North America, with rates higher in East Asia, where up to 80% of teenagers are affected.[4] The prevalence of myopia significantly increases in certain regions of the world, specifically in Asia.[5-9] The number of people with myopia is anticipated to rise from 1406 million in 2000 to 4758 million in 2050 and high myopia (spherical equivalent at least - 6.0D) from 163 million in 2000 to 938 million in 2050.[4] Hyperopia and astigmatism also present significant concerns, though their prevalence is generally lower than that of myopia.

Numerous environmental factors, including socioeconomic conditions, near work, and lack of outdoor activities, have possible associations with risks for developing myopia in children.[10,11] As digital device usage increases and educational environments evolve, understanding the prevalence and implications of refractive errors in children is becoming increasingly important. There are many studies regarding prevalence of myopia in school children.[12-14] However, many children get admissions in madrassas. This study was conducted to determine the prevalence and associated risk factors of myopia among madrassa students of District D. I. Khan.

## METHODS

This cross-sectional study was conducted on students in registered madrassas of district Dera Ismail Khan (D I Khan), one of the southern districts and divisions of Khyber Pakhtunkhwa province. The study was approved by the Advanced Study Research Board, Khyber Medical University Peshawar **(DIR/KMUAS&RB/FA/PM/00170).** Informed written consent was obtained from the students' parents or adult guardians with the assurance that each student had full right to participate, refuse or withdraw at any time he/she wanted. The study followed the tenets of the Declaration of Helsinki.

There are 276 registered madrassas in district D I Khan. A total of 25000 students are studying in these madrassas. Sample size was calculated through Rapid Assessment of Avoidable Blindness (RAAB). The desired sample size n was calculated as n= (Z2xPx (1-P)/e2=1700. By adjusting 10% non-compliance, the sample size was 1870. We used a two-stage sampling technique to assess the prevalence of myopia in Madrassa students. In stage I, a total of 43 strata were identified by the probability proportionate to size method. In stage 2, we selected 44 students from each stratum by simple random sampling technique to get the required sample size. All students, including male and female, of selected madrassas having ages 6 to 18 years, were included. Those children whose parents did not signa consent form or had corneal opacity, lens opacity, or retinal pathology that affected refractive error were excluded. A total of 1870 students in the selected classes were invited to participate in the study. Among 1870 students, 1750 agreed for eye examination voluntarily, resulting in a participation rate of 93.6%.

The examination of students was performed by a team of seven members. One male optometrist for male students, one female optometrist for female students, one Aalim (religious school teacher) who communicated with madrassas, two male helpers or assistants for male madrassas, and two female helpers for female madrassas. A two-day training course was conducted by a trained optometrist for members. Training was given regarding visual acuity screening and data collection on a pre-designed proforma.

The children were examined in their classrooms. Ocular examination of each participant was conducted by a trained male optometrist in madrassas for boys and a trained female optometrist in madrassas for girls. A pre-tested validated questionnaire was used for data collection. Each participant underwent detailed ocular examinations, including:

1. A thorough history of each student, including information about eye problems, vision impairment, and glasses was taken.
2. A Snellen visual acuity chart was used to check distance visual acuity (VA). VA was measured using the patient's own glasses (if worn) at a distance of 6 meters for each eye separately. For participants who could not read English, a tumbling "E" notation of the Snellen visual acuity chart was used.
3. Torchlight was used for general examination and ocular deviation through Hirschberg. Binomage was used and direct ophthalmoscopy was performed to examine any opacity of the ocular media and fundus examination. Students with corneal opacity, lens opacity, or other pathology that affected refractive error were excluded from the study and referred to the hospital for further

evaluation. A message was sent to their parents through the Madrassa administration.

4. Refractive errors in students were determined by cycloplegic autorefraction when needed. Cycloplegic refraction was done using two drops of 1% cyclopentolate hydrochloride **(**Manufacturer Ethical Laboratories (Pvt.) Ltd, Lahore, Pakistan) instilled 5 minutes apart to each eye. Cycloplegia was considered complete if the child pupil was dilated to 6 mm or greater and a pupillary light reflex was absent after a further 15 minutes. Refraction was measured by an optometrist using a streak retinoscope (Heine Beta 200 LED Germany) in a dark room with a distance of 1.5 meters. Subjective refraction of students who had undergone cycloplegic retinoscopy, was performed on the next visit after three days. Subsequently, all participants underwent subjective refraction using standard techniques in order to prescribe optical corrections for refractive errors. The algebraic sum of the sphere and half of the cylinder was used to calculate the spherical equivalent (SE) refraction.
5. Each participant underwent an anterior and posterior segment examination using slit-lamp bio-microscopy and indirect ophthalmoscopy to rule out any ocular pathology.

Myopia was classified as a spherical equivalent (SE) refraction of at least -0.5DS (mild: -0.5DS to -2.750DS, moderate: -3.0DS to -5.75DS, high: -6.0DS and above).Hyperopia was defined as a spherical equivalent refraction of at least +2.0DS and astigmatism as ≥1.0DC.[15]

This study evaluated vision impairment based on the presenting visual acuity in the better-seeing eye. Visual acuity in the better-seeing eye was classified as no vision impairment if VA of the student was ≥ 6/12; vision impairment if VA was less than 6/18 to 6/60; severe vision impairment if VA was less than 6/60 to 3/60; and blindness if VA was less than 3/60 to Perception of light (PL) as per WHO classification.[16]

SPSS (Statistical Package for Social Sciences) version 19 (IBM Corp., Armonk, NY, USA) was used for analysis. Logistic regression was applied to investigate the association of myopia with outdoor activity, the distance between eyes and books, sleep duration, use of electronic gadgets, and study hours in the madrassa. Statistical significance was assumed at $p < 0.05$ within 95% confidence interval (CI).Data was presented in frequencies and cross-tabulation.

## RESULTS

The total number of students who participated in the study was 1750. Among the participants, 71.8% (n = 1256) were male students. Most of the madrassa students were in the age group between 10 and 13 years (43.0%; n = 596), followed by the age group between 6 and 9 years (34%; n = 596), and 14 to 18 years (23%; n = 402), respectively. Based on the presenting visual acuity, 14.2% (n = 249) of the 1750 students had vision impairment, with three participants in the legally blind category (VA ≤3/60). After correction of refractive error, 220 students out of the 249 students with vision impairment, got improvement in their VA up to 6/12 or better and 29 children remained visually impaired. At the time of presentation, the prevalence of vision impairment based on best-corrected visual acuity was 1.6% among madrassa students. Details about the status of the VA of the participants at the time of presentation and with best correction are given in Table 1.

The most common cause of vision impairment was refractive error (12.9%; n=225). Amblyopia accounted for 0.3% (n=6) while retinal disorder contributed to 1% (n=18). Myopia was the most common refractive error among the madrassa students contributing 11.3% (n= 197), followed by hypermetropia (4.2%; n=74). Astigmatism was noted in 1.5% (n=26). The

**Table 1:** *Status of vision impairment.*

| Distance visual acuity | At Presentation n (%) | After Correction of Refractive Error n (%) |
|---|---|---|
| Normal (VA≥6/12) | 1501(85.8) | 1721(98.3) |
| Mild vision impairment (6/12 >VA ≥6/18) | 101(5.8) | 5 (0.3) |
| Moderate vision impairment (6/18>VA≥6/60) | 111(6.3) | 13(0.7) |
| Severe vision impairment (6/60>VA≥3/60) | 34(1.9) | 11(0.6) |
| Blind (VA<3/60) | 3(0.2) | 0(0.0) |
| **Total** | **1750(100)** | **1750 (100)** |

prevalence of myopia in girls (12.8%) was higher than in boys (12.8% vs 10.4%), but the difference was not significant (p=0.096). Prevalence of myopia was significantly increased with the increasing age (P=0.01)as shown in Table 2.

Outdoor activity of up to two hours had no significant effect on the prevalence of myopia (P=0.255). It was highly affected by near working distance (distance between book and eyes) (p<0.000). Odd ratio and 95% were calculated by using logistics regression (Table 3).

Frequency of myopia decreased with increased sleep duration (p=0.000). There was a significant effect of screen use time on myopia (P=0.000). The frequency of myopia was nearly reduced by half among individuals who did not use electronic gadgets, compared to those who used them continuously for half an hour or more. Additionally, study hours in madrassas had a significant effect on the prevalence of myopia (p = 0.000) (Table 4).

**Table 2:** *Age wise distribution of myopia.*

| Age Group (Years) | Frequency of Myopia | Percentage of Myopia (%) | P-value |
|---|---|---|---|
| 6 to 8 | 19 | 4.3 | |
| 9 to 11 | 55 | 10.8 | |
| 12 to 14 | 73 | 14.1 | P<0.001 |
| 15 to 18 | 47 | 17.0 | |
| **Total** | **194** | **11.1** | |

**Table 3:** *Correlation of myopia with outdoor activity from Saturday to Thursday.*

| Outdoor Activity (Hours/Day) | Frequency of Myopia | Percentage (%) of Myopia | P-value |
|---|---|---|---|
| ≤0.5 | 98 | 9.5 | P=0.255 (OR=1.209; 95%CI .872 to 1.67) |
| 0.5 to 1 | 94 | 13.5 | |
| 1 to 2 | 2 | 10.0 | |
| **Total** | **194** | **11.1** | |

**Table 4:** *Correlation of myopia with working distance, sleep duration per day, use of electronic gadgets and study hours per day in madrassa.*

| | Characteristics | Frequency of Myopia | Percentage (%) of Myopia | P-value |
|---|---|---|---|---|
| Working distance in centimeters | >30 | 5 | 6.9 | P<0.001 (OR=0.354;95% CI 0.216 to 0.579) |
| | 20 to 30 | 170 | 10.7 | |
| | <20 | 19 | 20.4 | |
| Sleep duration in hours | ≤7 | 6 | 17.1 | P=0.000 (OR=1.957; 95% CI 1.349 to2.839) |
| | 8 | 155 | 13.7 | |
| | 9 | 33 | 5.8 | |
| | ≥10 | 0 | 0 | |
| Use of electronic gadget (hour/day) | 0 | 129 | 9.2 | P=0.000 (OR=0.492; 95% CI 0.379 to 0.638) |
| | ≤0.5 | 53 | 18.9 | |
| | 0.5 to 1 | 12 | 17.4 | |
| Study hours per day in madrassa | <2 | 0 | 0 | P=0.000 (OR=0.404; 95% CI 0.290 to0.563) |
| | 2 to 4 | 63 | 7.5 | |
| | 4 to 6 | 125 | 15.2 | |
| | 6 to 8 | 6 | 46.2 | |

## DISCUSSION

Findings from this study showed that refractive error is the leading cause of vision impairment in madrassa students of district Dera Ismail Khan. Myopia is the most common refractive error in these students. The prevalence of myopia was higher in females as compared to males, but the difference was not statistically significant (p=0.096). The percentage increased with the increasing age group. Near working distance, sleep duration, continuous use of electronic gadgets, and study hours per day were the significant risk factors for the development of myopia. Outdoor activities had no significant effect on the prevalence of myopia in madrassa students in our study.

Findings from this study indicated that 11.1% of madrassa children aged 6 to 18 years in district Dera

Ismail Khan had myopia. This number is higher than that of a study conducted on primary school children with a mean age of 8.1, in Lakki Marwat, where the prevalence was 2.3%. However, the it is less as compared to another study conducted in Haripur madrassas where the prevalence of myopia was 21.6% in students of 5 to 15 years of age.[17] A study conducted in Delhi reported13.1% students with a mean age of 11.6 years had myopia.[18] Another study conducted in Chaoyang district showed a higher prevalence of myopia (36.7%) in children age 5 to 15 years.[19] A possible explanation of this variance may be age differences, the difference in sampling method, difference in definitions adopted, and differences in ethnic background.

Our results indicated a higher prevalence of myopia in females (12.8%) compared to males (10.4%); however, this difference was not statistically significant (p = 0.096). Similar findings have been reported in studies conducted among primary school children in Lakki Marwat and madrassa students in Haripur, where females also exhibited a higher prevalence of myopia.[20] Studies conducted in Delhi and Chaoyang district also reported a significantly higher prevalence of myopia in females (p=0.004)[18] (p=0.015).[19]

Results from our study demonstrated that the prevalence of myopia significantly increases with age (p=0.001). These findings are consistent with the results from studies conducted in primary school children of Lakki Marwat and madrassa students of Haripur.[17,20] Studies conducted in Delhi, Guangzhou, and Chaoyang district of China reported similar results (p<0.001)[18] (p<0.001).[15,19] The possible cause of this relationship may be an increasing requirement for reading and other visual activities in older children.

Outdoor activity is considered a protective factor against myopia. A study conducted in Beijing reported that increased outdoor activity was associated with decreased myopia.[21] Other studies showed similar results.[2,22] Our study did not find any association of myopia with outdoor activities (p=0.255). Results from this study are aligned with the study conducted in Guangzhou, which did not find any significant association between myopia and outdoor activity.[15] The possible reason for this may be that outdoor activities are greater in older Madrassa children. Increasing age is associated with an increase in myopia, so the protective effect of outdoor activities is counterbalanced.

Sleep duration is significantly associated with myopia in our study (OR=1.957; 95%CI 1.349 to 2.839). This result is in alignment with another study conducted on schoolchildren in China, which also showed that sleeping late was a risk factor for developing myopia (OR=1.55, p=.04).[23] A cross-sectional study conducted in Korea concluded a significant relationship between myopia and sleep duration (OR=0.59; 95%CI 0.38 to 0.93).[24]

In our study, myopia was significantly associated with the use of electronic gadgets such as mobile, tablets and computers (OR=.492; 95% CI .379 to .638). Similar results were reported in a study conducted in Beijing in which myopia was significantly associated with the use of computers (OR=1.52; 95% CI 1.16 to 2.0).[19] A study conducted in Guangzhou also reported myopia is significantly associated with use of electronic gadgets and computers (p<.001).[15]

The current study demonstrated that study hours in Madrassas students were significantly associated with myopia (OR=.404; 95% CI .290 to .563). These results are consistent with studies conducted in Delhi, India, Chaoyang District of China, and Guangzhou, which reported that those students who spent more time in reading were more likely to develop myopia.[15,19] A study conducted in Anyang showed different results in which duration of near work was not associated with myopia (p=0.83).[25] Near working distance is a known risk factor for developing myopia. Our findings show that the prevalence of myopia was highly effected by near working distance (p=0.000). Studies conducted in Chaoyang, Anyang, and Guangzhou showed that the prevalence of myopia was significantly affected by near working distance.[15,19,25]

## CONCLUSION

The leading cause of vision impairment in madrassa students of district Dera Ismail Khan was refractive error. Myopia was the most common refractive error in these students. Myopia was common in females and increased with age. Near working distance, sleep duration, continuous use of electronic gadgets, and study duration were the risk factors for myopia.

**Funding:** This study was not funded by any organization.

**Patient's Consent:** Researchers followed the guide lines set forth in the Declaration of Helsinki.

**Conflict of Interest:** Authors declared no conflict of interest.

**Ethical Approval:** The study was approved by the Institutional review board/Ethical review board **(DIR/KMU-AS&RB/FA/PM/001701)**.

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## Authors Designation and Contribution

Saleem Khan; Optometrist: *Concepts, Design, Literature Search, Data Acquisition, Data Analysis, Statistical Analysis, Manuscript Preparation, Manuscript Editing, Manuscript Review.*

Mufarriq Shah; Associate Professor: *Concepts, Design, Literature Search, Data Acquisition, Data Analysis, Statistical Analysis, Manuscript Preparation, Manuscript Editing, Manuscript Review.*

Sanaullah Jan; Professor: *Concepts, Design, Literature Search, Data Acquisition, Data Analysis, Statistical Analysis, Manuscript Preparation, Manuscript Editing, Manuscript Review.*

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