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Comparative study of the prevalence of myopia and its associated risk factors in India: medical versus non-medical students

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ABSTRACT

The purpose of this study is to determine the epidemiological aspects and prevalence of myopia and to compare the difference in myopia prevalence and common risk factors in medical and non-medical students. A cross-sectional, questionnaire-based study was initiated after approval from the Institutional Ethics Committee. Students of Indian origin, age group 18-26 years, of either gender were divided into Group I - Medical students and Group II - Non-medical students. A self-designed, semi-structured questionnaire was sent via the internet to students meeting the inclusion criteria. This study sample consisted of 308 medical and 183 non-medical students. Myopia prevalence was 71.1% in medical and 70.4% in non-medical students and was more in the female gender in both groups. Astigmatism was observed significantly more in medical myopes as compared to non-medical myopes (p= 0.0015). The age of onset of myopia in the medical and non-medical groups was 14.29 years and 14.59 years respectively. Medical students were exposed to significantly more near work compared to non-medical students (p= 0.008). Significantly more emmetropes take a break after 30 minutes of continuous reading (p=0.0036) while significantly more myopes reported using a blue light filter/anti-glare glasses while using digital screens (p= <0.0001). Factors such as outdoor activities, sleep patterns, and parental history were not found to be significantly associated with myopia.

There is a high prevalence of myopia in Indian students and most students were found to develop myopia before getting admission into their respective colleges.

KEYWORDS: Myopia, Prevalence, Medical, Non-medical, Risk factors

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INTRODUCTION

Myopia or nearsightedness is a type of ocular refractive error in which, when the accommodation is at rest, parallel rays of light coming from infinity are focussed in front of the retina. Recognized as one of the leading causes of vision loss all over the globe, myopia is estimated to affect 2.5 billion people by 2030 alone.[1] Numerous epidemiological studies point to the confirmation of a high prevalence of myopia in Asia. From 2001 to 2015, the prevalence of overall myopia increased from 79.5% to 87.7% in China.[2]

Even though the mechanisms of development and progression of nearsightedness remain uncertain, both genetic and environmental aspects have been shown to influence myopia. Studies demonstrate the relationship between environmental factors, such as a higher level of education, more near-work, and lesser outdoor activities and genetic factors like parental history with myopia in an individual. It was found in the Sydney Myopia Study that spending more time outdoors was associated with less myopia in children.[3] Sherwin et al reported that increasing the time spent outdoors by an additional hour per week brings down the risk of myopia by 2% and that spending more time outdoors reduced the progression of myopia significantly.[4] Similarly, in a study conducted in Turkey where medical students aged between 18 and 26 years were followed up for 1 year, outdoor activity during early childhood was documented to possess a protective effect against myopia in multivariate analysis.[5] The medical curriculum involves extensive and long-duration near work including reading, writing, and working with microscopes and sophisticated high precision instruments. In addition to the use of electronic gadgets, medical students have to go through greater numbers of hours of reading and get less time for outdoor activities, thereby making them more prone to developing refractive errors, particularly myopia. The prevalence of refractive errors in studies conducted in Indian Medical students at Kerala[6], Gujarat[7], and Odisha[8] were 42%, 48%, and 49.6% respectively. Although with the distinctive rise in e-learning, students of all academic fields have become prone to develop myopia.

Myopia encompasses medical burdens such as pathological complications like macular degeneration, choroidal neovascularization, cataract, and glaucoma along with a significant economic burden.[9] A thorough literature search revealed only one Indian study comparing the prevalence and likely contributory factors of common refractive errors among medical students vis-à-vis non-medical students of the same age in which the prevalence of myopia was found to be 69% and 32% respectively.[10]

To study the etiological factors that are unknown or under-studied, this study was planned with the following objectives:

1. To determine the epidemiological aspects and prevalence of Myopia.
2. To compare and determine the difference in Myopia prevalence and common risk factors in the two groups (Medical and Non-medical students).
3. To discuss preventive measures to impede refractive error development or progression.

MATERIALS AND METHODS

This was a cross-sectional, questionnaire-based study, initiated after approval from the Institutional Ethics Committee of Government Medical College (GMC), Nagpur (IEC number: EC/Pharmac/GMC/NGP/2312) and was conducted in accordance with the Declaration of Helsinki. The pre-tested, semi-structured Questionnaire was shared via the internet with Medical and Non-medical students of the 18-26 age group, forming the study population.

Students of Indian origin, age group 18-26 years, and of either gender were included in the study while students of Indian origin who were studying outside India and those refusing to give informed consent were excluded. Students meeting the selection criteria were briefed about the study and informed consent was obtained from those willing to participate.

This study sample consisted of 308 medical students and 183 non-medical students. Enrolled students were divided into Group I - Medical students and Group II - Non-medical students.

The information was entered over a period of 2 weeks in a self-designed, semi-structured questionnaire which was prepared and evaluated for content validity by one Ophthalmologist, one Community health expert, and a Biostatistician.

The questionnaire consisted of three parts:

Part I: Socio-demographic characteristics: age, gender, residence, education.

Part II: Clinical characteristics: Type of refractive error, age of onset of myopia, degree of myopia, type of corrective device used.

Part III: Environmental and behavioural patterns: Hours of sleep, screen time, performing eye exercises, outdoor activities, use of blue light filter, hours of near work, smartphone usage, computer/laptop usage, taking a break after 30 mins of continuous reading.

The questionnaire was pre-tested in 10 students for its formal assessment of comprehensiveness, clarity, and face validity, and suitable modifications were done.

Statistical analysis

Numerical continuous variables (eg. age) have been expressed as mean±standard deviations.

Categorical variables (eg. gender, residence) have been expressed as counts/percentages.

Student demographics and different aspects of myopia risk factors in the two groups i.e Medical and Non-medical have been compared by fisher's exact test for categorical variables and unpaired t-test for numerical variables.

All statistical tests were considered significant at a 95% confidence interval and *P*-value less than 0.05. The software Graphpad Prism was used for Statistical analysis.

RESULTS

Our study population of 491 participants consisted of 308 medical students and 183 non-medical students. The mean±SD age for the medical group was 21.36±1.20 years and that for the non-medical group was 20.91±1.55 years. There were 178 females and 130 males in medical and 88 females against 95 males in the non-medical test group. The study population consisted of 45 rural participants and 446 urban participants from varied socioeconomic conditions.

The medical student test group was found to have 53.8% myopes (166 students), 17.2% combined myopia with astigmatism (53 students), 1.3 % with only astigmatism (4 students), 0.64% hypermetropes (2 students), and 0.32% combined hypermetropia with astigmatism (1 student). While the non-medical test group showed 63.3% myopes (116 students), 7.1% combined myopia with astigmatism (13 students), 1.1% with astigmatism, and hypermetropia (2 students each). Also, 26.3% of medical and 26.2% of non-medical students were found to have no refractive error.

Among the total participants, 71.1% of medical students (219 students) and 70.4% of non-medical students (129 students) were found to be myopic.

75.2 % of medical females were myopic compared to 77.2% non-medical females (p= 0.7624) whereas 65.3% of medical males were myopic compared to 64.2% of non-medical males (p= 0.8881).

Out of the 219 myopes in the medical group and 129 myopes in the non-medical group, astigmatism was observed in 24.2% and 10.0% of medical and non-medical myopes respectively (p= 0.0015).

The average age±SD of myopic participants in the medical group was 21.34±1.29 years and that in the non-medical group was determined as 20.79±1.58 years (p= 0.0011). The age of onset±SD of myopia in the medical group was 14.29±3.79 years and in the non-medical group was 14.59±3.14 years (p= 0.4273).

Table 1: Degree of myopia of study participants

Degree of myopia	Number of participants		
	Medical (n=219)	Non-medical (n=129)	P-value
< -2 D	93 (42.4)	52 (40.3)	0.7361
-2 D to -6 D	110 (50.2)	70 (54.2)	0.5058
> - 6 D	16 (7.3)	07 (5.4)	0.6559

Figures in parentheses indicate the percentage.

87.6% medical and 90.6% of non-medical myopes used spectacles (p=0.4823) as their corrective device of choice whereas a combination of both contact lens and spectacles was preferred by 11.8% medical and 9.3% non-medical myopes (p=0.4837). It was also determined that 71.2% of medical and 70.5% of non-medical myopes wear corrective devices all the time whereas 28.7% of medical and 29.4% of non-medical myopes wore corrective devices only during lectures, studying, driving, and watching TV (p=0.9032).

54.4% of medical myopes and 49.7% of non-medical myopes reported a positive parental history of myopia whereas 53% and 64% of emmetropes in the medical and non-medical group respectively reported a positive parental history of myopia. There was no statistically significant difference between myopes and emmetropes in the two groups as far as parental history of myopia was concerned. (p= 0.0824 and 0.1928 for medical and non-medical group respectively). Behavioural (modifiable) risk factors for total students with myopia and total students with emmetropia are given in Table 2.

Table 2: Behavioural characteristics of study participants- Myopes versus Emmetropes

Parameter	Number of participants		P-value
	Total Myopics (n=348)	Total Emmetropics (n=129)	
Sleep (in hrs/day): Not fixed >9 hours 7-9 hours	 048 (13.7) 014 (4.0) 255 (73.2)	 20 (15.5) 03 (2.3) 96 (74.4)	0.7729

<6 hours	031 (8.9)	10 (7.7)	
Takes break after 30 minutes of continuous reading: Yes N	 179 (51.4) 169 (48.5)	 86 (66.6) 43 (33.3)	**0.0036**
Use of blue light filter/anti-glare glasses while using digital screen: Always Sometimes Never	 160 (45.9) 088 (25.2) 100 (28.7)	 20 (15.5) 32 (24.8) 77 (59.6)	**<0.0001**
Outdoor activities(hours/day): <1 1-2 ≥ 2	 187 (53.7) 130 (37.3) 031 (8.9)	 61 (47.2) 53 (41.0) 15 (11.6)	0.4034
Near work* (hours/day): ≤ 2 hours 2-4hours 4-6 hours 6-8 hours	 66 (18.8) 111 (31.6) 76 (21.6) 98 (27.9)	 35 (27.1) 38 (29.4) 30 (23.2) 26 (20.1)	0.1349

Figures in parentheses indicate the percentage.

*Near work includes reading, playing musical instruments, playing on handheld consoles, writing, painting, watching television, board games

The results showed that a greater percentage of myopes sleep for less than 6 hours per day compared to emmetropic students (p= 0.7729). 66.6% of emmetropes were found to take a break after 30 minutes of continuous reading compared to just 51.4% of myopes (p= 0.0036). While 71.1% of myopes reported using a blue light filter/anti-glare glasses while using digital screens, 59.6% of emmetropes never used any of the above methods (p <0.0001). More percentage of myopes in both the groups performed less outdoor activities per day than emmetropes; however, the difference was not found to be statistically significant (p= 0.4034).

It was found that computer usage (Laptop/Desktop/Tablet) among non-medical myopes was significantly more than medical myopes. (p<0.0001) [Table 3]

Table 3: Computer/Laptop/Tablet usage by myopes (in hours per day)

Computer/Laptop/Tablet usage (in hours/day)	Number of participants		P-value
	Medical myopes (n=219)	Non-medical myopes (n=129)	
>3	39 (17.8)	78 (60.4)	**< 0.0001**
2-3	27 (12.3)	18 (13.9)	
1-2	36 (16.4)	22 (17.0)	
≤1	52 (23.7)	08 (6.2)	
0	65 (29.6)	03 (2.3)	

Figures in parentheses indicate the percentage.

While the medical students were exposed to significantly more near work (reading, playing musical instruments, playing on handheld consoles, writing, painting, watching television, board games) compared to non-medical students. (p=0.008) [Table 4]

Table 4: Near work (in hours per day)- Medical Versus Non-medical

Near work* (in hours/day)	Number of participants		P-value
	Medical (Myopes+Emmetropes) (n=300)	Non-Medical (Myopes+Emmetropes) (n=177)	
≤ 2 hours	50 (16.6)	51 (28.8)	**0.008**
2-4hours	91 (30.3)	55 (31.0)	
4-6 hours	75 (25.0)	31 (17.5)	
6-8 hours	84 (28.0)	40 (22.5)	

Figures in parentheses indicate the percentage.

*Near work includes reading, playing musical instruments, playing on handheld consoles, writing, painting, watching television, board games

Behavioral (modifiable) risk factors for medical myopes and emmetropes, and non-medical myopes and emmetropes are given in Table 5.

Table 5: Behavioural (modifiable) risk factors for medical myopes and emmetropes, and non-medical myopes and emmetropes

Parameter	Number of participants			
	Medical		Non-medical	
	Myopes	Emmetropes	Myopes	Emmetropes
Total Number of participants	219	81	129	48
Frequency of performing eye exercises*:				
Multiple times a day	03 (1.3)	03 (3.7)	02 (1.5)	01 (2.0)
At least once a day	17 (7.7)	06 (7.4)	11 (8.5)	03 (6.2)
2-3 times a week	26 (11.8)	07 (8.6)	09 (6.9)	04 (8.3)

Once week	25 (11.4)	11 (13.5)	21 (16.2)	08 (16.6)
Never	148 (67.5)	54 (66.6)	86 (66.6)	32 (66.6)
Frequency of eye checkups annually:				
>2 times	09 (4.1)	02 (2.4)	07 (5.4)	01 (2.0)
1-2 times	163 (74.1)	16 (19.7)	90 (69.7)	12 (25.0)
None	47 (21.4)	63 (77.7)	32 (24.8)	35 (72.9)
Computer use (in hours per day) [Laptop/Desktop/Tablet]				
>3	39 (17.8)	10 (12.3)	78 (60.4)	25 (52.0)
2-3	27 (12.3)	08 (9.8)	18 (13.9)	08 (16.6)
1-2	36 (16.4)	15 (18.5)	22 (17.0)	06 (12.5)
≤1	52 (23.7)	17 (20.9)	08 (6.2)	04 (8.3)
0	65 (29.6)	31 (38.2)	03 (2.3)	05 (10.4)
Smartphone use (in hours per day)				
>3	161 (73.5)	59 (72.8)	83 (64.3)	32 (66.6)
2-3	38 (17.3)	20 (24.6)	33 (25.5)	07 (14.5)
1-2	16 (7.3)	01 (1.2)	11 (8.5)	09 (18.7)
≤1	04 (1.8)	01 (1.2)	02 (1.5)	0 (0)
Near work (in hours per day)**				
≤2	31 (14.1)	19 (23.4)	35 (27.1)	16 (33.3)
2-4	67 (30.5)	24 (29.6)	41 (31.7)	14 (29.1)
4-6	53 (24.2)	22 (27.1)	23 (17.8)	08 (16.6)

6-8	68 (31.0)	16 (19.7)	30 (23.2)	10 (20.8)
Outdoor activities (in hours per day)				
<1	113 (51.5)	39 (48.1)	74 (57.3)	22 (45.8)
1-2	86 (39.2)	33 (40.7)	44 (34.1)	20 (41.6)
≥2	20 (9.1)	09 (11.1)	11 (8.5)	06 (12.5)

Figures in parentheses indicate the percentage.

*Eye exercises such as gaze training, eye movements, and refocusing to tackle strain.

**Near work includes Reading, playing musical instruments, playing on handheld consoles, writing, painting, watching television, board games.

As far as eye exercises such as gaze training, eye movements, and refocusing to tackle strain are concerned, the responses revealed that barely 9% and 10% of medical and nonmedical myopes respectively, and 11.1% and 8.2% of medical and nonmedical emmetropes respectively performed eye exercises at least once a day. 77.2% of Myopes get at least 1 eye check-up annually whereas only 24% of emmetropes get the same. A high degree of smartphone usage was found in both the groups, with 73.5% myopes and 72.8% emmetropes in the medical group and, 64.3% myopes and 66.6% emmetropes in the non-medical group reporting a daily usage of greater than 3 hours.

Myopia was found to impose a substantial economic burden on the students with 21.9% medical myopic and 10.8% non-medical myopic students spending greater than INR 2500/year on eye consultations and corrective devices whereas 33.7% and 44.9% medical myopic and non-medical myopic students respectively confirmed an expenditure lying between INR 1000 and INR 2500 annually, owing to myopia.

While the vast range of reasons for ophthalmologist visit in our test population ranged from headache, blurring of vision, redness, eye ailments like stye, raised IOP, lacrimation, and regular/follow-up eye check-ups, the most common complaints among myopic students were found to be blurring of vision and headache whereas the same in emmetropic students were determined to be eye redness and headache.

The psychosocial impact of visual impairment corrective devices was studied and it was found that wearing them resulted in issues like affected appearance, low self-confidence, altered self-image, name-calling, bullying, inconvenience, and dependency. The affected appearance came out to be the most commonly cited issue by students of both medical and non-medical myopic groups.

DISCUSSION

Our study population of 491 participants consisted of 308 medical students and 183 non-medical students. We found a very high rate of myopia prevalence in Indian students; out of the total participants, 348 (70.8%) were myopic. Myopia prevalence was 71.1% in medical students and 70.4% in non-medical students, thus showing no significant difference which is in contrast to an earlier study that reported a large difference in myopia prevalence between medical(69%) and non-medical students(32%).[10]

The prevalence of refractive errors in similar studies conducted in Indian medical students at Kerala[2], Gujarat[3], and Odisha[4] were 42%, 48%, and 49.6% respectively which is less than the 71.1% of prevalence our study found.

Myopia prevalence was found to be more in females, with 75.2 % and 77.2% of medical and non-medical females respectively suffering from myopia compared to 65.3% of medical males and 64.2% of non-medical males. This finding was consistent with the studies conducted in Kerala[6], where 45.33% of the females compared to just 32% of males had myopia, and Haryana[11], where 62.7% of the females compared to just 42.4% of males had myopia.

Astigmatism was observed significantly more in medical myopes (24.2%) as compared to non-medical myopes (10.0%).

In our study, there was no significant difference between the age of onset of myopia in the medical and non-medical groups which was 14.29 years and 14.59 years, respectively, suggesting that most students develop myopia before getting admission into their respective colleges. The age of onset of myopia was similar to what Kumar et al.[11] found but was lesser than the mean age at which refractive error was diagnosed in the Odisha study [8] which was 16.47 years.

In our study degree of Myopia was found to be less than -2 D in 42.4% medical myopic and 40.3% non-medical myopic students, between -2 D and -6 D in 50.2% medical myopic and 54.2% non-medical myopic students and greater than -6 D in 7.3% medical myopic and 5.4% non-medical myopic

students. Unlike the NIM study [12], Gujarat study [7], and Kumar et al.[11], neither of the two groups in our study reported any significant association with parental history.

On evaluating the effect of behavioural (modifiable) risk factors on myopia we found that 66.6% of emmetropes take a break after 30 minutes of continuous reading compared to just 51.4% of myopes thus long sessions of near work, like reading, may be associated with myopia development. More percentage of myopes in both groups were found to perform less outdoor activities per day than emmetropes which were in agreement with Singh et al [13] and NIM study[12]. Also, a greater percentage of myopes were found to sleep for less than 6 hours per day compared to emmetropic students which were in agreement with the study conducted in Gujarat.[7] In our study, most myopes reported using a blue light filter/anti-glare glasses while using digital screens while 59.6% of emmetropes never used any of the above methods, which suggests that the students after getting diagnosed with myopia tend to take more care of their eye by using blue light filters and anti-glare glasses.

We found that medical students were exposed to significantly more near work compared to non-medical students. The computer usage among non-medical myopes was found to be significantly more than medical myopes, which is probably due to the curriculum requirement of non-medical students, particularly in the engineering stream. The degree of smartphone usage was more in the medical group with 73.5% myopes and 72.8% emmetropes compared to the non-medical group where 64.3% myopes and 66.6% emmetropes reported a daily usage of greater than 3 hours.

Performing eye exercises such as gaze training, eye movements, and refocusing to tackle strain was studied. The responses revealed that barely 9% and 10% of medical and nonmedical Myopes respectively, and 11.1% and 8.2% of medical and nonmedical emmetropes respectively performed eye exercises at least once a day. There is no evidence to support the benefits of eye exercise in myopia. [14]
We found that 77.2% of myopes get at least 1 eye check-up annually whereas only 24% of emmetropes get the same, percentage of myopes getting at least 1 eye check-up annually in our study is lesser than Odisha study[8] where about 90% of myopes had at least 1 ophthalmological check-up in the last 12 months.

The most common reasons for ophthalmologist visits among myopic students were found to be blurring of vision and headache whereas the same in emmetropic students were determined to be eye redness and headache.

Myopia was found to impose a substantial economic burden on the students with 21.9% medical myopic and 10.8% non-medical myopic students spending greater than INR 2500/year on eye

consultations and corrective devices. The psychosocial impact of visual impairment corrective devices was studied and 'affected appearance' came out to be the most commonly cited issue by students of both medical and non-medical myopic groups. There were many studies conducted with regards to the psychology of wearing eyeglasses that found that individuals who are wearing glasses tend to be seen as more intelligent [15,16], but less attractive [17,18].

The major strength of our study: is the sample size which is more than most of the cross-sectional studies on this topic; there is only one study in India, apart from ours, comparing myopia and its associated risk factors in medical and non-medical students; our study not only takes into account parental history and modifiable risk factors like digital screen usage, near work, outdoor activities but also looks into the economic and psychological impact of myopia on the students.

Our study has the following limitations: Response bias, as the questionnaire was sent using internet-based methods more students with myopia choosing to participate in the study than the students without myopia may have led to overestimation of myopia prevalence; as the study was conducted during the Covid pandemic it was not possible to verify the degree of myopia claimed by the students.

CONCLUSION

In our study, the prevalence of myopia was found to be similar in medical and non-medical groups with astigmatism being observed significantly more in medical myopes as compared to non-medical myopes. Myopia prevalence was more in the female gender in both groups. The age of onset of myopia in the medical and non-medical groups was 14.29 years and 14.59 years respectively. Medical students were exposed to significantly more near work compared to non-medical students. Significantly more emmetropes take a break after 30 minutes of continuous reading while significantly more myopes reported using a blue light filter/anti-glare glasses while using digital screens. Myopia was found to impose a substantial economic burden on the students. 'Affected appearance' was the most commonly cited psychosocial impact of visual impairment corrective devices. Factors such as outdoor activities, sleep patterns, and parental history were not found to be significantly associated with myopia.

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