Original Article

Association of near work and dim light with myopia among 1400 school children in a district in North India

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Purpose: The aim of this study was to determine the association of near work and dim light with myopia among school children in a district in North India. **Methods:** This study included a total of 1400 children of either sex studying in classes 5-10 in various schools of a district in North India, after taking consent from their guardians. Visual acuity was measured using Snellen's chart. Myopes were called to our institute where wet retinoscopy was done and spectacles were prescribed. **Results:** There was a highly statistically significant correlation between myopia and increase in reading hours (P=0.001). There was a statistically significant correlation between myopia and >6hours of using mobile phones /week, more hours spent on using mobile phones correlated with an increased prevalence of myopia (P< 0.01). There was a statistically significant correlation between myopia and increasing hours of playing video games (P<0.01). We found a highly statistically significant positive correlation between the prevalence of myopia and reading in dim light (P=0.0006). **Conclusion:** There was a positive association between myopia and hours of doing near work. The prevalence of myopia increased with increased hours of doing near work (reading, playing video games and using mobile phones). The study showed a correlation between reading in dim light and myopia. Prevention of myopia may be possible by avoiding these risk factors.

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Myopia has been recognized as the most common cause of correctable visual impairment in the developed countries in adults and children and is a leading cause of preventable blindness in developing countries.[1] According to a study, one in six people of the world's population is myopic, which becomes more significant in countries such as India.[2] It is the most common cause of refractive errors worldwide with an estimated 22.9% of the world's population, or 1.406 billion people, being affected throughout the world. A study has estimated that about half of the world's population will be myopic by 2050.[3] In India, uncorrected refractive errors such as myopia are the most common cause of visual impairment and the second major cause of avoidable blindness.[4] Both genetic and environmental factors work in conjugation in its genesis. Environmental factors such as insufficient light exposure, low physical activity, and near work increase the risk. The hypothesis for this says that there is a lack of normal visual stimuli which causes improper development of the eyeball. More time spent indoors and dim light have been postulated to increase the risk of myopia.[5] Studies have shown a positive correlation between hours spent on doing near work and the development of myopia.[6,7] Increased hours spent on near work have been associated with a higher degree of myopia.[8] Near work included in the study included hours of reading for pleasure, studying, watching television, and playing computer/video games.[9,10] Previous studies performed in India have found a positive association of myopia with children studying or reading >5 hours per day, watching television >2 hours/day, and playing computer or video games or mobile games.[11-13] However, very few studies have been conducted in our area in school-going children in classes 5–10, and this cohort is most vulnerable to myopia. The study was hence performed with the aim to determine the association of near work and dim light with myopia among school children in a district in North India so that strategies can be developed to decrease the prevalence of myopia.

Methods

This prospective interventional study was conducted in five schools selected randomly in a district in North India and included a total of 1400 children of either sex studying in classes 5–10 in various schools. Initially, details regarding the project were communicated to the principal/head of schools. A list of children studying in various classes of the schools was prepared by the respective principals. All students who were willing to participate in the study in classes 5–10 were included in the study. This study was a cross-sectional study. A total of 1400 children studying in classes 5–10 were screened in schools. The sample size was calculated by the following formula:

$$n = 2pqZ^2/l^2$$

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n = sample size

p = prevalence16 = 13.1%

q = (100-p)

l = maximum acceptable random sampling error

Z = critical value of the normal distribution at alpha/2 (e.g., for a confidence

level of 95%, alpha is 0.05 and the critical value is 1.96)

Putting the values into the formula,

$n = 2*13.1*86.9*(1.96)^2/(2.5)^2 = 1400$

Hence, this study was conducted among 1400 children.

A classroom with good lighting was chosen in each school. The visual acuity of each eye was measured separately at a distance of 6 meters. The test distance was measured using a measuring tape. Snellen's chart was hung on the wall, and students were asked to read the letters. Snellen's chart in both English and Hindi was used on the basis of students' preference. The vision was tested separately for each eye, followed by dry retinoscopy in a dark room. Our study proformas were duly filled for each child. The proforma/questionnaire was taken from a previous study conducted in India.[14] Those students who had myopia were called to our institute where retinoscopy was repeated and appropriate spectacles were prescribed to the child. The collected data were then entered in an M.S. Excel sheet and were evaluated using SPSS software. This was then followed by counseling and motivation of these children to wear spectacles. Children along with their parents were made aware of the risks of not being compliant to the prescribed spectacles.

Results

Out of the 1400 students screened, 711 (51%) were females and 689 (49%) were males. There were 237 (33.3%) females and 177 (25.7%) males in the 5–8 years age group, 345 (48.5%) females and 339 (49.2%) males in the 9–12 years age group, and 129 (18.1%) females and 173 (25.1%) males in the 13–16 years age group. The mean age ± standard deviation for overall females in the study was (9.86 ± 2.78), and for males, it was (10.46 ± 2.78). The total number of myopes was 487, the total number of emmetropes was 876, and the total number of hypermetropes was 37.

Table 1 shows the distribution of myopes and emmetropes according to hours spent on reading. Apart from these students, there were 37 students with hypermetropia. Among the myopes, 112 (23%) studied for ≤10 hours/week, 213 (43.7%) studied for 11–20 hours/week, and 162 (33.3%) studied for 21–30 hours/week. In our study, when myopia was correlated with reading hours, there was a highly statistically significant correlation between myopia and reading for ≤10 hours/week versus 11–20 hours/week ($p = 0.001$) and 21–30 hours/week versus ≤10 hours/week ($p = 0.0001$). However, no statistical association was found when myopia was compared between reading for 11–20 hours/week and 21–30 hours/week. There was a positive statistical correlation between increased hours spent on reading in myopes when compared with emmetropes ($p < 0.01$).

Table 2 shows the distribution of myopes and emmetropes according to hours spent on playing video games. Among the myopes, nine (1.8%) did not play video games, 141 (29%) played video games for up to 7 hours/week, 167 (34.3%) played video games for 8–14 hours/week, and 170 (34.9%) played video games for >14 hours/week. On correlation of myopia with hours of playing video games, there was a statistically significant correlation between myopia and increasing hours of playing video games ($p < 0.01$); with increasing time spent on playing video games, the prevalence of myopia increased. There was a positive statistical correlation between hours spent on playing video games in myopes when compared with emmetropes ($p < 0.05$), with children with myopia having spent more hours on playing video games than emmetropia.

Table 3 shows the distribution of myopes and emmetropes according to hours of using mobile phones. 14.8% (72) myopes and 6.7% (59) emmetropes used mobile phones for >6 hours/week. When myopes and emmetropes were compared for hours of using mobile phones, there was a statistically significant correlation between the hours of using mobile phones and the prevalence of myopia ($p < 0.01$).

Table 4 shows the prevalence of reading in dim light (light intensity less than 1000 lux) among emmetropes and myopes. Among the myopes, 219 (45%) read in dim light and 268 (55%) did not. In our study, there was a highly statistically significant positive correlation between the prevalence of myopia and reading in dim light ($p = 0.0006$). Furthermore, when compared with emmetropes, there was a significant statistical correlation between the two ($p = 0.041$).

Discussion

Our study found a positive correlation between the prevalence of myopia and hours of reading. More the time spent on reading, more was the prevalence of myopia. This is in accordance with the study performed by Saxena *et al.*,[12] who showed that there was a positive correlation between myopia and children reading >5 hours per day. Singh *et al.*,[13] in their study, found a positive association between myopia and children studying for more than 4 hours per day. Guo *et al.*,[15] in a cross- sectional

Table 1: Distribution of emmetropes and myopes according to reading hours

Reading Hours	*n* (%)			*P* among myopes	*P* (Emmetropes versus Myopes)
	Total	Emmetropes	Myopes		
≤10 hours/week (Group 1)	500 (35.7%)	376 (42.9%)	112 (23%)	Group 1 versus 2=0.001	0.001
11-20 hours/week (Group 2)	540 (38.6%)	314 (35.8%)	213 (43.7%)	Group 2 versus 3=0.098	0.004
21-30 hours/week (Group 3)	360 (25.7%)	186 (21.2%)	162 (33.3%)	Group 3 versus 1=0.0001	0.001
Total	1400 (100%)	876 (100%)	487 (100%)		

Table 2: Distribution of emmetropes and myopes according to hours of playing video games

Hours of playing video games	*n* (%)			*P* among myopes	Emmetropes versus Myopes (*P*)
	Total	Emmetropes	Myopes		
No (Group 1)	16 (1.1%)	7 (0.8%)	9 (1.8%)	Group 1 versus 2=0.037	0.085
7 hrs/week (Group 2)	448 (32%)	300 (34.2%)	141 (29%)	Group 2 versus 3=0.089	0.045
8-14 hrs/week (Group 3)	524 (37.4%)	342 (39%)	167 (34.3%)	Group 3 versus 4=0.003	0.021
>14 hrs/week (Group 4)	412 (29.4%)	227 (25.9%)	170 (34.9%)	Group 4 versus 1=0.023	0.0001
Total	1400 (100%)	876 (100%)	487 (100%)		

Table 3: Distribution of emmetropes and myopes according to hours of using mobile phones/week

How many hours do you use mobile phones?	*n* (%)			Emmetropes versus Myopes (*P*)
	Total	Emmetropes	Myopes	
>6 hours/week	132 (9.4%)	59 (6.7%)	72 (14.8%)	0.0009

Table 4: Distribution of prevalence of reading in dim light among emmetropes and myopes

Do you read in dim light?	*n* (%)			*P* among myopes	Emmetropes versus Myopes (*P*)
	Total (%)	Emmetropes	Myopes		
No (Group 1)	785 (56.07%)	543 (62%)	268 (55%)	Group 1 versus 2=0.0006	*P*=0.041 (E >M)
Yes (Group 2)	615 (43.92%)	333 (38%)	219 (45%)		*P*=0.041 (M >E)
Total	1400 (100%)	876 (100%)	487 (100%)		

study in Guangzhou, showed that reading for more than 2 hours per day was positively correlated with prevalence of myopia. Harrington *et al*.[16] showed a positive correlation between myopia and reading. Xie *et al*.[17] and Tideman *et al*.[18] also found a significant association between the two.

Our study found a statistically significant correlation between myopia and increasing hours of playing video games; with increasing time spent on playing video games, the prevalence of myopia increased. There was a positive statistical correlation between hours spent on playing video games in myopes when compared with emmetropes. This is in accordance with the study performed by Wakode *et al*.,[11] which found a strong positive correlation between myopia and playing video games. Similar results were obtained by Saxena *et al*.,[12] Singh *et al*.,[12] and Xie *et al*.[17] in their studies.

The present study showed a statistically significant correlation between the myopia and hours of using mobile phones; more the hours spent on using mobile phones, more is the prevalence of myopia. This is in accordance with the studies performed by Saxena *et al*.,[12] Singh *et al*.,[13] and Harrington *et al*.,[16] which showed similar results.

In our study, there was a highly statistically significant positive correlation between the prevalence of myopia and reading in dim light. Wu *et al*.,[19] in their school-based cluster randomized trial, showed how good light exposure results in significantly less myopic shift.

Conclusion

All these findings lead to the conclusion that here was a positive correlation between the prevalence of myopia and increasing hours of doing near work. More the number of hours spent on activities such as reading, playing video games, and using mobile phones, more was the prevalence of myopia. Because the prevalence of reading in dim light was much more in myopes than emmetropes, there was a protective role of adequate light exposure in the prevention of myopia. Because near work and studying in dim light are modifiable environmental factors, by modifying these, we can decrease the prevalence of myopia significantly in the population. Students should be motivated to cut down on hours spent on playing video games and using mobile phones. Parents should ensure that their children are studying in a well-lit room. If both parents and children are motivated and educated properly, we can substantially decrease the amount of risk associated with myopia.

Proper refraction with well-fitting optical devices, identifying the risk factors, and educating all the children with refractive errors the importance of wearing spectacles can help decrease the burden associated with myopia. Hence, this can avoid the serious complications associated with myopia. As there is no well-established or universally accepted method for the prevention of myopia onset, it is important to identify modifiable risk factors associated with its development and create cost-effective interventional strategies.

A unique part of our study was that it included the COVID-19 pandemic period, during which classes and examinations were largely online, along with variable restrictions on outdoor activities. The use of mobile phones by school-going children escalated, and we found a strong correlation between increased hours of mobile phone usage and myopia. No previous study of this kind is available in the literature in our state. Our findings will go a long way in developing strategies to prevent myopia.

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Conflicts of interest

There are no conflicts of interest.

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