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A study on prevalence of myopia and causative factors among primary and middle school students in Hyderabad, India

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Abstract

Shortsightedness (Myopia) is a growing concern among school going children in India and developing East Asian countries. 27% (1893 million) people are affected with myopia worldwide with 2.8% of them are high myopic as per the reports published by WHO in year 2010. The prevalence of myopia is highest in East Asia, where as China, Japan, the Republic of Korea and Singapore have a prevalence of approximately 50%, and lower in Australia, Europe and north and South America, based on Preliminary projections 52% will be affected with myopia by the end of 2050 [1] . In an another report published by WHO declared 4949 million people will be affected and 80% of them will be schools going students in Asia. The condition of myopia may be presented as eye rubbing and squeezing of eyes and blurred vision. Myopia commences in schools around 5-15 years of age and tends to stabilize in later age and is mainly idiopathic. High myopia may be associated with myopic macular degeneration, cataract, glaucoma, peripheral retinal changes and retinal detachment. As per the WHO report major causes of visual impairment in myopia whether corrected or not corrected [2]. As there is no well established or universally accepted method for the prevention of myopia and its onset it is more important to identify risk factors associated with myopia and to create cost effective interventional procedures. However myopia imposes a great health risk and its causative factors whether it is environmental or familial need to be studied. Current research aims to estimate the prevalence and to access contributing factors which causes myopia among primary and middle school students with objective to be explored are 1). To estimate prevalence of myopia among primary and middle school students. 2). To identify the causative factors which contributes to myopia?

A cross sectional study based on student population studying in primary and middle private schools in Hyderabad. Multi-stage stratified cluster sampling method was used to select study participants. In stage 1 we selected randomly 10 high schools in central Hyderabad and stage 2 three grades of primary school and 2 grades of the middle school were selected randomly. The selection participants were strictly adhered to inclusion criteria and exclusion criteria. Sample size was calculated by using

statistical tools at 95% CI and 247 students were enrolled for the study. The mean refractive error was -2.33(±1.7) D in myopic students and overall prevalence of myopia was 61.5% and 95% CI= 59.5-76.4% and no myopia was 38.5%. Regarding categories of myopia, the prevalence of high myopia was 4%, moderate myopia was 12.95% and low myopia was 44.53%. The prevalence of myopia in students is increased along with the growth of grade level and statistically significant $p<0.05$ between students of myopia and no myopia. The demographic and modifiable risk factors were estimated have shown that the student with myopia spent more time engaged in reading or studying for school assignments, pleasure reading daily, using computer and electronic gadgets weekly, watching television less than 10 feet are compared with no myopia ($p<0.05$). Analysis revealed odds ratio >1 for all modifiable risk factors, time spent at school > 7 hours ($p<0.0001$), school assignments> 2 hours per day ($p<0.05$), pleasure reading > 1 hour per day ($p<0.0001$), use of electronic gadgets > 7 hours per week ($p<0.0001$) are positively correlated with no myopia students, statistically significant by x^2 (Chi-square) test. Students whose reading distance is < 25 cm ($p<0.05$) and watching television <10 feet of distance ($p<0.05$), outdoor activity <7 hours per week ($P<0.01$) are positively correlated with myopia students. The other probable causative factors, size of the class room, sitting distance from the board and ventilation to natural light was also correlated in our studies. Statistical analysis of size of the class room (m^2) with myopic and non myopic students revealed a positive correlation, a linear regression was calculated along with ANOVA ($F=458.3$, $p<0.0001$) and it was statistically significant. Myopia or near sightedness among the primary and middle school students It is a significant public health problem in Hyderabad. Needs the attention of the policy makers and researchers and public health professionals to develop certain rules and introduce new methods of teaching in class rooms and interventions to decrease the prevalence of myopia among school students. Further educational campaigns directed at families and schools are needed to improve awareness of the serious consequences of myopia among school students and adopt interventional methods like eye exercises for 10 to 15 min to be introduced in their school protocol.

Key words: Causative factors, Environmental factors, Eye exercises Myopia, Hypermetropia.

Introduction

Myopia is defined as a condition in which the spherical equivalent objective refractive error is ≤ - 0.5 Diopter (D) in either eye. The definition of high myopia is a condition in which the spherical equivalent objective refractive error is ≤ 5 Diopter (D) in either eye. In recent decade's familial history of myopia along with environmental factors are widely acknowledged. In an early survey conducted in India by Jain *et al*., in 1970 4.79% of school going students has shown a prevalence of myopia in Chandigarh. In urban population 6.9% which is higher when compared to rural population 2.77% [3]. Prevalence of refractive error and related visual impairment in school going children 5-15 years of age, in an urban population in New Delhi and reported a prevalence of 7.4% of myopia by Murthy *et al*.,[4]. Uncorrected refractive errors are the second major causes of visual impairment in India. A survey conducted in 1989 by WHO 1.49% population in India is blind out of which 7.35% is due to refractive errors [5]. The National Blindness Survey (NPCB) declared 19.7% of blindness due to refractive errors even though the overall prevalence of blindness was reduced to 1.1% [6]. In other study conducted in 2001, the prevalence of myopia at an urban location in Delhi was 7.45% and 4.1% at a rural location Mahmood Nagar in Andhra Pradesh [7,8]. A study in Andhra Pradesh authors reported

that refractive error is the main cause of moderate visual impairment among the younger groups and is a major public health problem in India [9]. The possible association of environmental factor has been linked for the development of myopia among the schools going students [10]. Factors such as long time near work, distance between watching Television and use of electronic gadgets, ventilation of class room for natural light, artificial light, distance of sitting arrangement from the board, physical activity and exposure to day light all these factors [11]. The current research aims to estimate the prevalence and contributing factors which causes myopia among primary and middle school students with its causative factors.

Materials and Methods

Study design and participants:

This cross sectional study based on sample of student in primary and middle school attending private schools in Hyderabad. Multi-stage stratified cluster sampling method was sued to select study participants. In stage 1 we selected randomly 10 high schools in central Hyderabad and stage 2 three grades of primary school and 2 grades of the middle school were selected randomly. Out of all available students in selected classes from each grade 5 students were selected randomly upto 25 students per school expect the 10th school were 22 students were selected to match the sample size as per statistical calculation. The selection participants were strictly adhered to inclusion criteria and exclusion criteria. Sample size was calculated by using statistical tools at 95% CI and 247 students were enrolled for the study (Figure 1 and 2). Informed consent from each child examined in primary school and middle school were obtained from parents. Questionnaire was asked to fill from the parents of primary school but middle school students were asked to fill by their own to avoid the bias, after the nature of the study was explained and declaration used was Helsinki. The study was approved by the Institutional Ethical Committee (IEC) letter dated 12th of august (MMCH/IEC/2018/21).

$$\text{Sample Size}(n) = \frac{Z^2_{1-\alpha/2}\, p(1-p)}{d^2}$$

Figure 1 – calculation of sample size

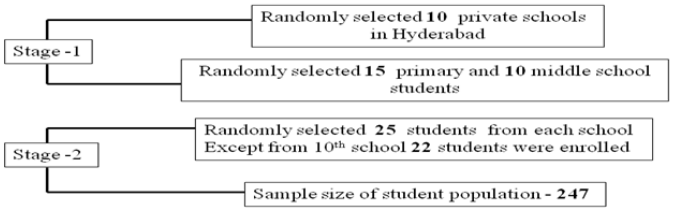


Figure 2 - Experimental Design

Measurement of refractive error:

Manual methods were followed by an expert optometrist and Snelen's chart was used to test the far vision and Gagger's chart was used for near vision at individual school campus. Cyclopegia was induced with two drops of 1% cyclopetolate hydrochloride instilled 5 min apart to each eye after instillation 0.5% proparacaine hydrochloride, with a third drop instilled after a min, as per procedure follow by optometrist and ophthalmologist. Pupillary dilation upto 6mm or greater and light reflex was performed and found to be absent in all subjects was consider as cyclopegic eye and manual refraction was done.

Questionnaire

The research assistant visited the school before 2 days of the eye examination to distribute questionnaire forms to study participant and the participants of middle school were asked to fill the questionnaire form on the same day. Participants of the primary school were asked to get the form filled from one of the parents and return it on eye examination day. Questionnaire contains information of sociodemographic factors were collected including

gender, age, grade, level, ethnicity, family history and school academics. In our study, participants asked to fill, 1. Time spent on reading at school, 2. Time spent at home on home work, 3. Pleasure reading, 4. Time of using electronic gadgets per week, 5 Distance of watching television, 6. Parental myopia (either parents or single parent) and 7. Outdoor activity per week.

Statistical analysis

All statistical analysis was conducted by using (Graph Padprism, Version-7, USA). Data represented as number (%), Mean ± SD. The prevalence rate and 95% CI of myopia were reported. In our study we used multiple stage sampling and students were grouped by schools, and therefore may not be independent, two level multiple logistic regression analysis in which schools were treated as clusters, were performed by using Graphpad prism (7), USA. All statistically significant factors in the univariate analysis were further analysed by using multivariate logistic models to determine the risk factors for myopia in school students on odds ratio and relative risk and 95% CI. An odds ratio>1 with p<0.05 risk factors are considered to be significant.

Results

This was a cross sectional study with a aim to estimate prevalence of myopia among primary and middle school students and its causative factors, a total no of 247 participants were enrolled for the study from 10 private schools in Hyderabad. The mean refractive error was -2.33(±1.7) D in myopic students and overall prevalence of myopia was 61.5% and 95% CI= 59.5-76.4% and no myopia was 38.5%. Regarding categories of myopia, the prevalence of high myopia was 4%, moderate myopia was 12.95% and low myopia was 44.53%. The prevalence of myopia in students is increased along with the growth of grade level and statistically significant p<0.05 between students of myopia and no myopia. The demographic and modifiable risk factors were estimate are shown in table1, student with myopia spent more time engaged in reading or studying for school assignments, pleasure reading daily, using computer and electronic gadgets weekly, watching television less than 10 feet are compared with no myopia (p<0.05). Analysis revealed odds ratio >1 for all modifiable risk factors, time spent at school > 7 hours (p<0.0001), school assignments> 2 hours per day (p<0.05), pleasure reading > 1 hour per day (p<0.0001), use of electronic gadgets > 7 hours per week (p<0.0001) are positively correlated with no myopia students, statistically significant by x2 (Chi-square) test. Students whose reading distance is < 25 cm (p<0.05) and watching television <10 feet of distance (p<0.05), outdoor activity <7 hours per week (P<0.01) are positively correlated with myopia students. The other probable causative factors, size of the class room, sitting distance from the board and ventilation to natural light was also correlated in our studies. Statistical analysis of size of the class room (m2) with myopic and non myopic students revealed a positive correlation, a linear regression was calculated along with ANOVA (F=458.3, p<0.0001) and it was statistically highly significant (Figure 3).

Table 1: Demographic and behavioral risk factors

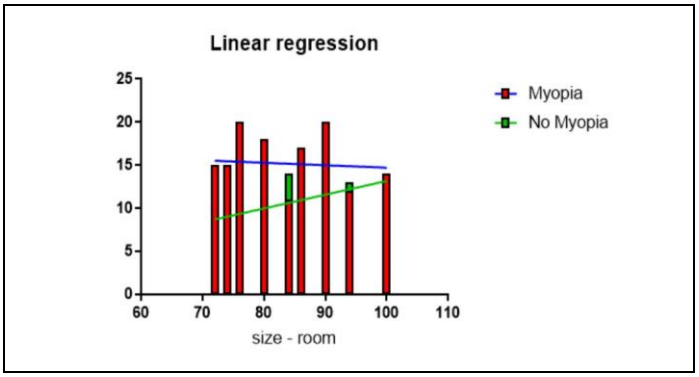
Variables	Myopia, n(%)	No myopia n (%)	Total n (%)	P value
Students enrolled[a]	152* (61.5)	95* (38.5)	247 (100)	<0.0001
Refractive error[b]	-2.33 ± 1.7	-0.25± 0.0	-	<0.0001

Myopia categories Myopia Low myopia Moderate myopia High myopia	 95 (38.5) 110 (44.53) 32 (12.95) 10 (4.04)	 - 	 - 	 -
Hours of reading at school per day <7 hours >7hours	 40 112	 60 35	 100 147	 <0.0001
Hours of reading at home per day ≤2 hours >2 hours	 48 104	 35 60	 83 164	 <0.004
Pleasure reading per day ≤ 1 hour > 1 hour	 54 98	 41 54	 95 152	 <0.0001
Use of electronic gadgets per week ≤ 7 hours > 7 hours	 60 92	 90 05	 150 97	 <0.05
Distance reading (cm) ≤25 cm >25cm	 115 37	 93 02	 208 39	 <0.05
Distance of watching television (feet) ≤10 feet >10 feet	 143 09	 02 93	 145 102	 <0.0001
Parental myopia Both parents Single parent	 155 55	 92 37	 247 92	 <0.0002
Outdoor activity <7 hours per week >7 hours per week	 145 07	 2 93	 147 100	 <0.01

Table 1 - Values presented as n (number), percentage (%), Mean±SD. [a]*statistically significant with ANNOVA (F= 458) Multiple comparison Dunnet's test was used. [b]t-test between myopia and no myopia. X^2 tests were used to

examine the difference between myopia and no myopia group with expected behavioral and environmental risk factors.

Figure 3: Relation of size of the class room with myopia and no myopia students



Discussion

Our study based on manual refraction indicated that the overall prevalence of myopia was 61.5% (95% CI =59.57 to 76.43%) among primary and middle school students in Hyderabad which was higher than found in earlier survey in 2004, which demonstrated that 38.1% of school students were myopic in Delhi [12]. This data can reflect that there might be an increase in the prevalence of myopia in school children in Hyderabad. In addition a previous study in 2012 showed that prevalence of child myopia in Korea was 22.6% and recent study in the united state demonstrated that the prevalence of myopia in non-Hispanic white children was only 1.20% and in Asian children was 3.98% [13]. The prevalence of myopia is lower in these studies when compare to our study. The possible explanation for the variance in the prevalence of myopia in students could be differences in the nature of the samples ethnic background, age, or in the definition of myopia.

In addition the current results revealed that the prevalence of myopia is higher than the study conducted at Delhi that the children in the upper middle socioeconomic status had a slightly higher risk of myopia than that of lower socioeconomic status [14]. In the current study we not only evaluated the amount of time spent for reading or studying for school assignments, reading for pleasure, watching television, using computer and playing electronic gadgets, but also assessed the reading distance and the watching distance to the television. We revealed in our study that children with myopia spent more time engaged in reading or studying for school assignments daily, reading for pleasure daily, using computers weekly, using electronic gadgets weekly compared with students without myopia where found to be significant ($p<0.05$). Similar studies in china and Singapore found children with myopia spent more hours in reading per day, and a higher proportion used computers regularly [15]. Students engaged in reading both school work at home and pleasure reading is positively correlated with myopia in a study at USA in same study watching TV and playing electronic gadgets were negatively correlated [16] which was not in agreement to our study between myopic students and no myopic student groups. A possible explanation for the different results about hours spent on watching television and plying with electronic gadgets may be related to that the nearly universal exposure television or computer among students in the United States this different variable than Asia [17]. In addition, although many previous studies revealed that distance of near work was associated with myopia in students, some these studies consider distance of reading as an main factor which was associated with myopia [18,19]. Some authors have positively correlated near distance reading and near work with the myopia [20]. In current study myopic students have close relation with near distance reading and watching television from less than 10 feet which was in agreement with previous studies of myopia in Sydney showed that close reading 30cm independently increased the risk of myopia in students [21]. The results of the prior study in Singapore revealed that watching television less

than 3m (approximately 10 feet distance) are prone to myopia [22], the current study also positively correlated myopia with distance of watching television from less than 10 feet. Consistent with previous findings showing that parental myopia was significantly related to myopia, and illustrating an increased risk of myopia in children with increasing numbers of myopic parents [23,24,25,26]. The current study correlated that there was a trend of higher prevalence myopia among the school students who have parental myopic history either parents or one. Outdoor activity was recently shown to be another possible major environmental factor associated with myopia, it is possible that increasing outdoor activity time may protect students against myopia [27,28]. In a randomized clinical trial conducted at China demonstrated that an additional 40 min of outdoor activity may reduce the incidences of myopia among school students [29]. In this study we found the significant association with outdoor activity with myopia and highly significant.

The current study has noteworthy strengths including analysis of survey data that were collected from not only questionnaires but also refraction measurements. Further, the sample was randomized recruitment of student participants and sampling used was multi stage sampling and we used two stages of multiple analyses to explore the risk of independent risk factors for myopia among school students. In previous studies also multistage sampling method was used but did not adopt the analysis method. But in this studies questionnaire was completed by middle school students themselves to avoid the bias, only primary school enrolled students were asked to fill the forms in presence of their parents. We have taken precautions to avoid bias in our studies.

Conclusion

In conclusion myopia or near sightedness among the primary and middle school students is a significant public health problem in Hyderabad. It needs the attention of policy makers, researchers and public health professionals to draw certain rules and introduce new methods of class room teaching and interventions like eye exercise to decrease the prevalence of myopia among school students. Further educational campaigns directed at families and schools are needed to improve awareness of the serious consequences of myopia among school students. Adopting interventional methods like eye exercises for 10 to 15 min during the school hours to be introduced as their protocol in schools. Research on eye exercises to be adopted during school hours with more sample size is warranted.

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