

Impact of Outdoor Activities, Prevalence of Myopia & Its Associated Factors among Underprivileged Schoolchildren in Rural North India

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Abstract: Significance: Outdoor activities are as preventive measures for myopia progression, so awareness should be increased about this among school-children and their parents in rural area. **Purpose:** The major goal of this study was to investigate the prevalence of myopia and its associated factors among underprivileged school-children. **Methodology:** A cross-sectional study was conducted to estimate the prevalence of myopia among under-privileged school-children studying in 6th to 12th standards. A total of 2951 (mean age: 14±2.51 years) students (male=1594 & female=1372) were enrolled in this study. The subjects underwent a comprehensive eye examination. Information on the student's lifestyle, habits, study hours, indoor activities and outdoor playtime were collected using a self-structured questionnaire. The collected data were analyzed to explore the factors associated with myopia using the Bivariate correlation test and the adjusted odds ratio for each factor through SPSS-21. **Results:** Out of 5902 eyes, 562 (10.5%) eyes were having refractive errors; of which 58 (10.3%) were hypermetropic, 408 (72.6%) were myopic & 96 (17.1%) were astigmatic. Low myopia was the commonest myopia form in adolescent students (40.5%, N=165) as well as in adult students (59.5%, N=242). Commonly experienced symptoms were difficulty in seeing blackboard (76%, N=310) [OR=0.685, 95%, CI: 0.93-0.76], Headache (94.6%, N=386) [OR= 0.625, 95%, CI: 0.89-0.80], Eye-ache (58.1%, N=237) [OR=0.835, 95%, CI: 0.87- 0.82], Watery eye (76.2%, N=311) [OR=0.535, 95%, CI: 0.73- 0.61], Itching (51.4%, N=208) [OR=1.374, 95%, CI: 0.30- 0.19], Redness (4.2%, N=17) [OR=0.467, 95%, CI: 0.03-0.02] amongst the students. Higher age group students spent significantly more time on near work while less time on outdoor activities. All parameters were found to be statistically significant with the Pearson Bivariate correlation test. **Conclusion:** The prevalence of myopia tended to increase among children as age increases. More outdoor and less indoor activities had a protective effect on myopia.

Keywords: Myopia progression, Outdoor activities, Myopia control, Refractive errors.

INTRODUCTION

Globally, Myopia is the leading cause of correctable visual impairment and preventable blindness.

Myopia (short-sightedness) is a state of refraction in which parallel rays of light coming from infinity are focused in front of the retina, (when accommodation being at rest) due to having a long axial length or steep corneal curvature. [Belete, T. *et al.*, 2017; Saw, S. *et al.*, 2001]

Myopia is a major health issue globally. The World Health Organization (WHO) estimates that half of the population of the world may be myopic by 2050. [Morgan, I.G. *et al.*, 2012; Holden, B. *et al.*, 2016] In recent times, less time spent in outdoor activities has been recognized as a major risk factor for myopia development. [He, M. *et al.*, 2015; Lingham, G. *et al.*, 2020] The duration and intensity of near-work activities are also associated with myopia. [Wen, L. *et al.*, 2020] In January 2020, a novel coronavirus (severe acute respiratory syndrome coronavirus 2) rapidly spread in India and around the world. In response to the coronavirus disease 2019 (COVID-19) eruption, the Indian government started a nationwide school closure as an emergency measure to prevent the spreading of the infection at the end of March 2020. [wikipedia.org]

It is estimated that over 250 million students school-aged children and adolescents were confined to their homes; online courses were offered and delivered through the internet. Although these efforts have been shown to control the pandemic in India, concerns have been raised about whether the period of lockdown may have worsened the burden of myopia due to significantly decreased time spent outdoors and increased screen time at home. [Sumitha, M. *et al.*, 2020-Valentin, N. *et al.*, 2020] In this study, we aimed to investigate the association of home confinement during the COVID-19 outbreak with myopia development in school-aged children in India.

Myopia development and progression are considered to be multifactorial, with genetic and environmental factors contributory, though the contribution of genetics is considered small. Genes have been identified for myopia. [Farbrother, J.E. *et al.*, 2014- Rose, K.A. *et al.*, 2008] however genes are thought to work out one's susceptibility to environmental factors. [Lim, L.T. *et al.*, 2014] Several environmental factors have been identified, [Fledelius, H.C. *et al.*, 2014; Flitcroft, D. I, 2014] as well as an excessive amount of time spent on near work; [Morgan, I.G. *et al.*, 2012] lean time spent outdoors; [French, A.N. *et al.*, 2013]

low levels of vitamin D;[Yazar, S. *et al.*, 2014] inadequate light exposure;[Read, S.A. *et al.*, 2014] and poor diet.[Lim, L.S. *et al.*, 2010]

There is evidence rising that increased time spent outdoors can reduce the risk of developing myopia and – in those with myopia – it can reduce the speed of progression.[Wu, P.C. *et al.*, 2013; Morgan, I.G. *et al.*, 2014] Reduced rates of progression in summer compared to winter[Donovan, L. *et al.*, 2012] conjointly supports the hypothesis of the light theory. It's conjointly been shown in experimental animal models that a defocused retinal image will cause axial elongation of the eye, and hence myopia. While it seems unlikely that there will be a treatment that may completely prevent the development and progression of myopia, there are few promising treatments on the horizon.

These embrace providing a focussed image at all retinal locations to remove the stimulus to axial eye elongation. Executive bifocal spectacles[Cheng, D. *et al.*, 2014] peripheral plus contact lenses,[Sankaridurg, P. *et al.*, 2011] extended depth of focus contact lenses[censusindia.gov.in], and orthokeratology lenses [Si, J.K. *et al.*, 2015] are some of the optical intervention methods that show some efficacy in reducing the speed of progression of myopia (some by up to 51%). Pharmacological agents such as 0.01% atropine are being prescribed in Asia pacific, and show a reduction of up to 50% in the speed of progression of myopia, though there is no reduction in the rate of axial elongation.[Chia, A. *et al.*, 2012]

Worldwide, India is the second most populated country, with around 41% of its population (492 million) being less than 18 year age group.[censusindia.gov.in]



Figure 1: Current and projected 2050 myopia prevalence by region. (Courtesy from Mehta, *et al.*, 2019).

METHODOLOGY

Research Design

This study was a cross-sectional study among school-children in rural North India. The study included all the students (6th standard to 12th standard), who agreed to participate in this study. The study was conducted at four inter colleges of Etawah, U.P.

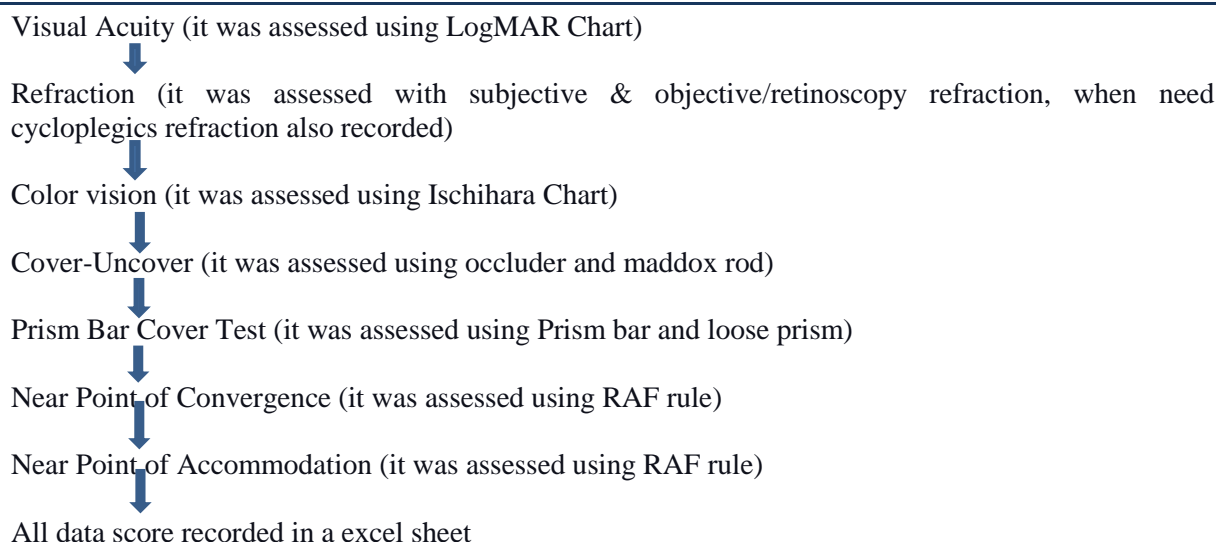
Time Frame- It was conducted between July to November month of 2019.

Sample Size- It was included 2951 participants including 6th to 12th standard students.

Sampling Procedure

This study was included clustered-sampling methods to collect the data by following the protocol of this study.

The subjects underwent a comprehensive eye examination assessment:



Information on the student's lifestyle, habits, study hours, indoor activities and, outdoor playtime were collected using a self-structured questionnaire and collected data recorded in excel sheet.

Inclusion criteria- It was included 6th to 12th standard students, who agreed to participate in this study.

Exclusion criteria- It was excluded primary school students (1st to 5th standards) and who was not agreed to participate in this study.

DATA ANALYSIS

Data were captured and analysed with the Statistical Programme of Social Sciences (SPSS) version 21. Descriptive statistics were used to analyse values such as frequencies, mean, standard deviation, cross tabulation and percentage of collected data. Pearson Bivariate correlation test and the adjusted odds ratio (OR) for each factor was estimated. A 'p' value of < 0.05 was considered as significant.

RESULTS

Out of 5902 eyes, 562 (10.5%) eyes were having refractive errors; of which 58 (10.3%) were hypermetropic, 408 (72.6%) were myopic & 96 (17.1%) were astigmatic. A higher prevalence of myopia was seen in the higher age-group.

Low myopia was the commonest myopia form in adolescent students (40.5%, N=165) as well as in adult students (59.5%, N=242). Myopia prevalence in girls (54.7%, N=223) was significantly higher than boys (45.3%, N=185). Commonly experienced symptoms were difficulty in seeing blackboard (76%, N=310) [OR=0.685, 95%, CI: 0.93-0.76], Headache (94.6%, N=386) [OR=0.625, 95%, CI: 0.89-0.80], Eye-ache (58.1%, N=237) [OR=0.835, 95%, CI: 0.87- 0.82], Watery eye (76.2%, N=311) [OR=0.535, 95%, CI: 0.73-0.61], Itching (51.4%, N=208) [OR=1.374, 95%, CI: 0.30- 0.19], Redness (4.2%, N=17) [OR=0.467, 95%, CI: 0.03-0.02] amongst the students. Higher age group students spent significantly more time on near work while less time on outdoor activities. All parameters were found to be statistically significant with the Pearson Bivariate correlation test.

Table 1: Age & Gender wise distribution of screened variables. (*Abbreviations: OD- Right eye, OS- Left eye, NPC- Near point of convergence)

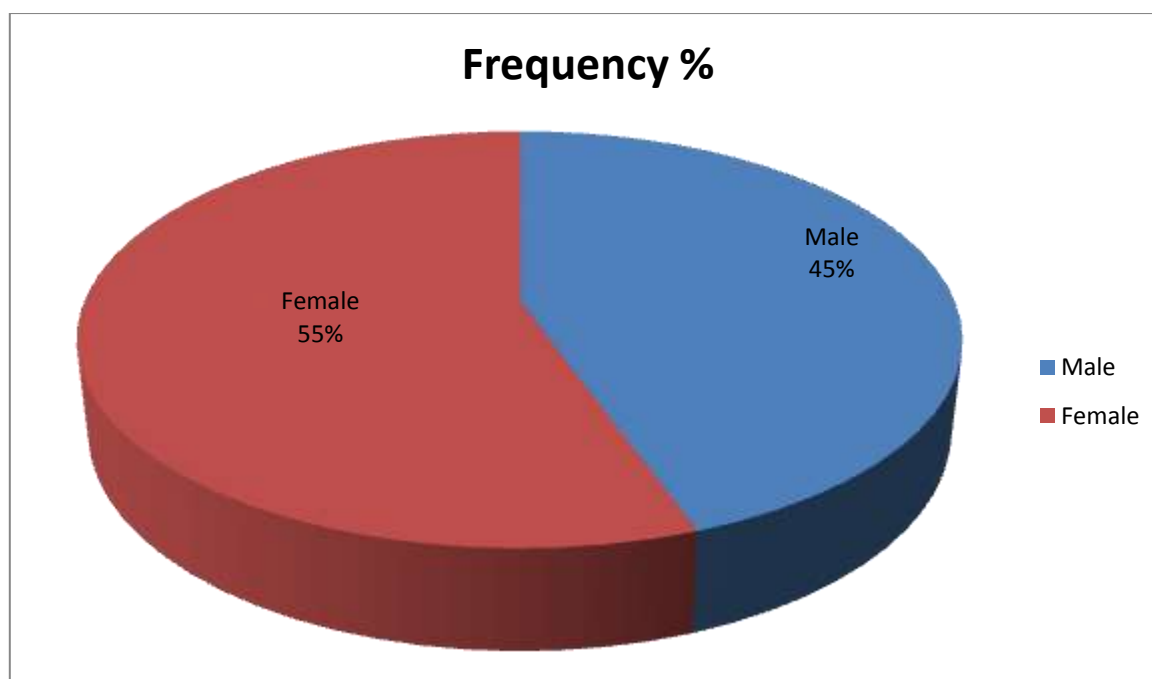
Characteristics	Myopic (N=408)		Phoria(N=331)	Color vision(N=45)	NPC(N=370)
	OD	OS			
Age (in years)					
9-11	35	34	79	16	79
12-14	71	60	81	12	105
15-17	92	95	152	14	165
18-20	10	11	19	3	21
Gender					
Male	96	89	168	32	151
Female	109	114	163	13	219

Table 2: Age & Gender wise distribution of degree of myopia

Characteristics	Myopic (N=408)							
	OD				OS			
	Very mild	Mild	Moderate	Severe	Very mild	Mild	Moderate	Severe
Age (in years)								
9-11	14	28	8	2	15	22	9	1
12-14	16	46	10	2	10	25	8	2
15-17	34	62	18	2	12	34	10	1
18-20	3	5	3	0	1	4	1	0
Gender								
Male	24	52	16	1	24	54	13	1
Female	30	65	16	3	38	56	12	3

Table 3: Gender wise factors/symptoms distribution of myopia (*Not significant)

Symptoms/ Factors	Gender			P-value
	Male	Female	Total	
Difficulty in seeing blackboard	126	184	310	P=0.049
Headache	189	197	386	P=0.014
Watery eyes	124	187	311	P=0.012
Itchy eyes	128	82	208	P=0.017
Eye-ache	116	121	237	P=0.026
Redness	6	11	17	P=0.099*
Outdoor activities	152	174	326	P=0.033
Indoor activities	128	146	274	P=0.046

**Figure 1:** Frequency distribution of myopia prevalence

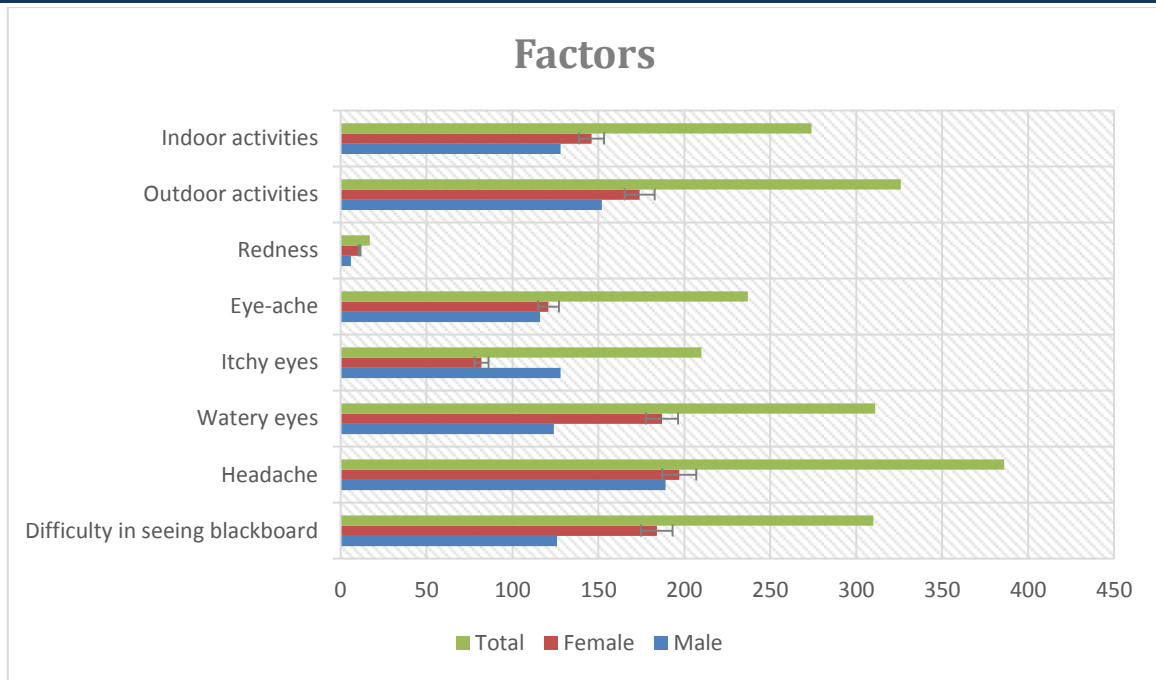


Figure 2: Factors/Symptoms distribution of myopia

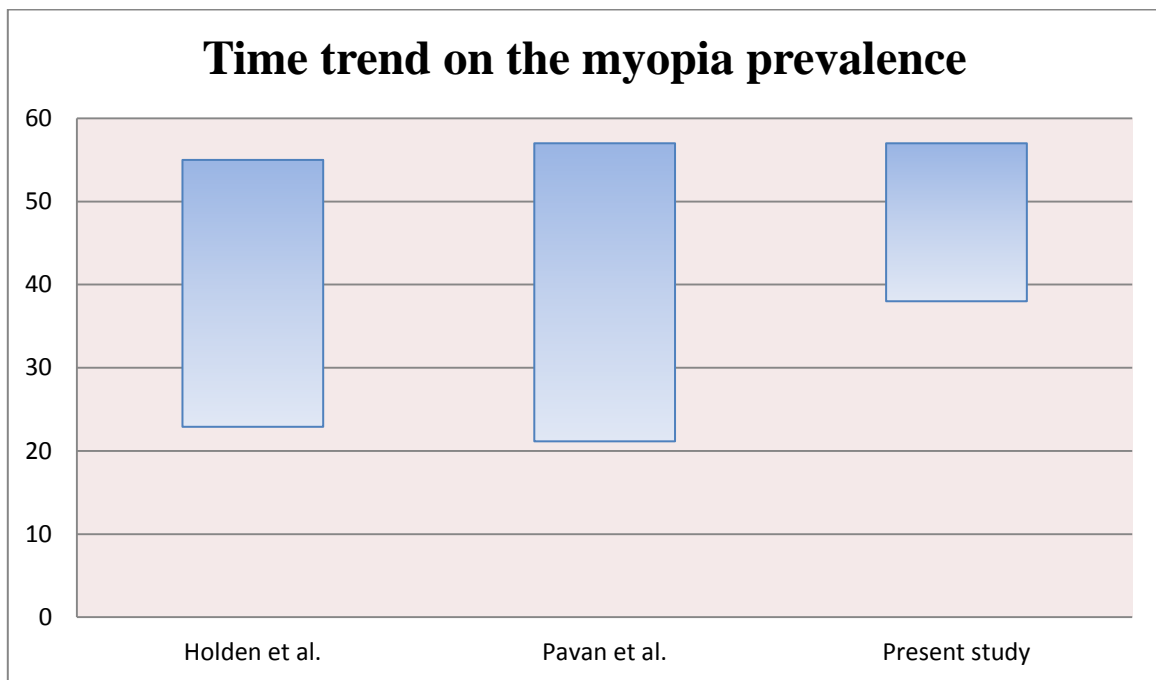


Figure 3: Comparison of time trends on the prevalence of myopia^{35 & 36}

DISCUSSION

In recent era, Myopia has tended to increase in number among East-Asian population and even in Indian population and has evolved as a major health burden for the nation. Study was conducted to find out the prevalence of myopia among school children and various factors associated with myopia.

A meta-analysis by Holden, *et al.*, 2016 and Pavan, *et al.*, 2021 predicts a twofold increase in myopia prevalence and sevenfold increase in the visual loss by myopia by 2050. These predictions may be hastened by the current pandemic, if immediate actions are not taken.

We discussed the few study of prevalence of myopia and associated factors in Indian as well as Abroad study given in below table:

Table 4: Discussion

Present study	Indian study[Neeraj, K. et al., 2019]	Ethiopia study[Assem, A.S. et al., 2019]
1. Study conducted in Etawah, North India.	1. Study conducted in Gurugram, North India.	1. Study conducted in Bahir Dar City, Ethiopia.
2. Cross-sectional school based study (July-Nov. 2019)	2. Cross-sectional school based study (Jan-Mar. 2019)	2. Cross-sectional descriptive study (Oct-Nov. 2019)
3. 2951 school-children (6 th -12 th standard) were screened.	3. 1234 school-children (aged 5-15 years) were screened.	3. 601 students were screened.
4. Myopia prevalence was found to be 9.5 % (Male-44% & Female-56%).	4. Myopia prevalence was found to be 21.1% (Male-52% & Female-48%).	4. Myopia prevalence was found to be 8.48% (Male-51% & Female-49%).
5. Data analysis was performed using Pearson Correlation coefficient by SPSS version 21.	5. Data analysis was performed using Logistic regression by SPSS version 23.	5. Data analysis was performed using Logistic regression by SPSS version 22.
6. A ‘p’ value of < 0.05 was considered as significant.	6. A ‘p’ value of < 0.05 was considered as significant.	6. A ‘p’ value of < 0.05 was considered as significant.

In our study we have used homatropine 1% to achieve cycloplegia, provide spectacles to every myopic students according to our affordability, but didn't use contact lens (dual focus or multifocal) and atropine intervention due to lack of income,

But in various studies, they have used and trial the various methods of myopia control interventions.[Cheng, D. et al., 2014- Yam, J.C. et al., 2019]

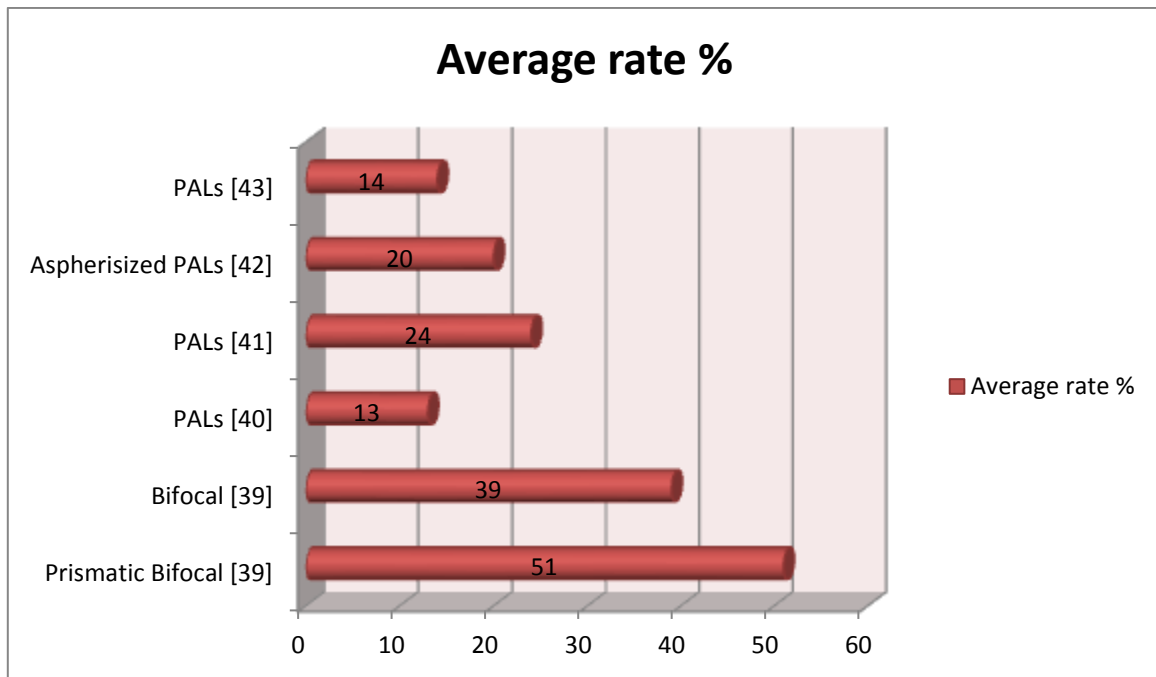


Figure 4: Average rate of myopia reduction with glass prescription

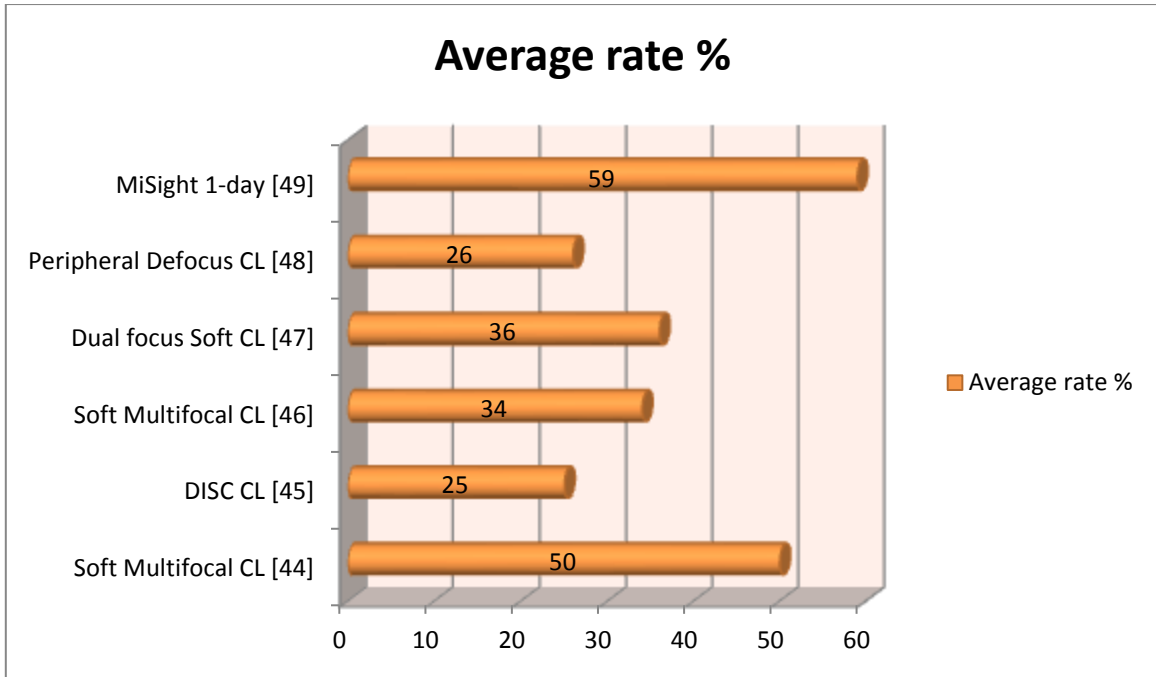


Figure 5: Average rate of myopia reduction with CL

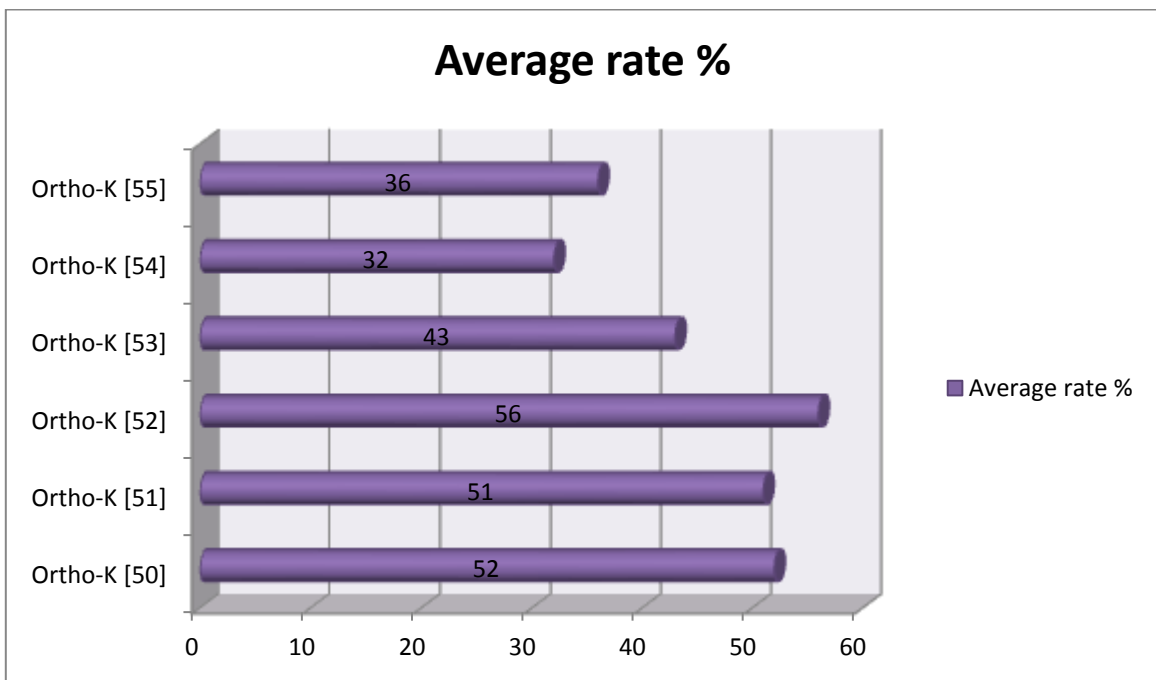


Figure 6: Average rate of myopia reduction with Ortho-K CL

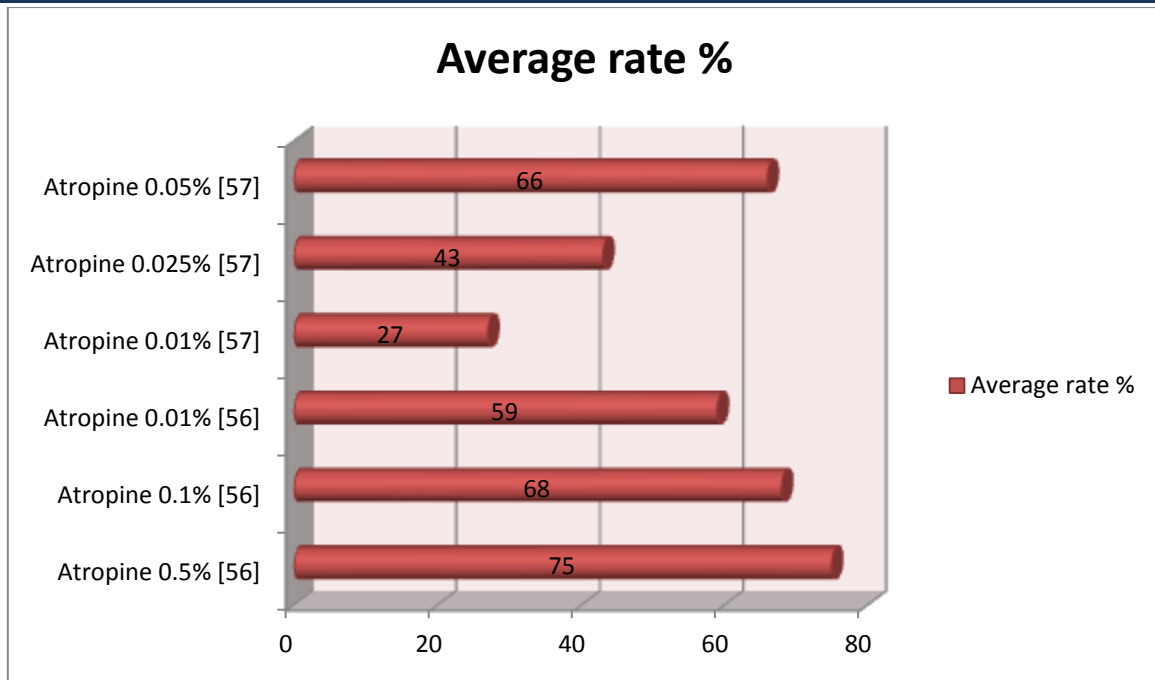


Figure 7: Average rate of myopia reduction with Atropine (with various percentages)

The limitation of our study is short study duration, small sampling area and lack of follow up of the students. So a more detailed study on large area for a longer duration along with their follow up with various myopia control interventions in India is recommended.

CONCLUSION

This study concluded that the prevalence of myopia tended to increase among children as age increases. In recent times, Age, lifestyle and continuous near work time (digital gadget use & study) without 5 minutes rest in half an hour were risk factors for myopia. Longer time spent on outdoor activities was significantly associated with a lower risk of myopia. These associative factors may indicate that low intensity in near work and more outdoor activities at least 2.5 hours per day may be important for future trials of intervention on myopia.

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