Original Research Article

Effect of Outdoor Activity in daylight over Myopia Progression in Young People: A Longitudinal Study

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DOI: 10.47750/pnr.2022.13.S06.201

Abstract

PURPOSE- To determine the effect of outdoor activities in daylight over myopia progression in young people

METHOD- This prospective observational single centered hospital-based study was conducted in Department of Ophthalmology of Shyam Shah Medical college and associated GM Hospital Rewa, during the period of January 2019 to September 2020. Cycloplegic autorefration with 1% cyclopentolate eye drop followed by subjective refinement of refraction was done and Spherical equivalent was calculated at baseline (Time 1), and then after 6 months (Time 2), and at 1 year (Time 3). Progression of myopia was calculated as the change in spherical equivalent during 1 year. Questionnaire survey about amount of time spent in outdoor activities in daylight was done. Multivariate analysis was done to estimate the adjusted odds ratio for outdoor activities associated with myopia progression.

RESULT-Significant increase in odds of myopia progression was observed in young people with shorter outdoor activity hours ($p<0.05$).

COCLUSION -Longer duration of outdoor activities in day light has protective effect over myopia progression ($p<0.05$).

KEYWORDS- myopia progression, outdoor activity, young people

INTRODUCTION

Myopia is becoming a major epidemiological problem and its prevalence is growing worldwide. By the year of 2050, 49.8% of the world's population is expected to be suffering from myopia and 9.8% from high myopia [1]. It is a common ocular disorder seen in children and young adults and a cause of concern [2-5]. High myopia is associated with increased risk of severe and irreversible loss of vision and may lead to certain comorbidities such as dense cataract, retinal detachment, sub retinal neovascularization and glaucoma [6,7,8].

Both environmental factors and genetic variations play important role in myopia onset and its progression. In various studies, environmental factors have been found to be significant determinants of refractive error [9,10]. Although a meaningful proportion of myopia cases can be explained by inheritance [11], strong environmental etiology cannot be excluded, especially in East Asia [12].

Some studies have shown that more exposure to day light and increased physical activity had a protective effect against myopia progression [13,14,15]. Few studies showed that violet light (VL, 360-400nm wavelength) which is available in day light during outdoor activity, suppresses myopia progression.[16]. Further support for the

influence of light or season over myopia progression comes from a study in which less myopia progression and axial elongation was occur in longer summer versus shorter winter days [13]. These results suggest that violet light is one of the important outdoor environmental factors for myopia control Additionally, various interventional studies showed that outdoor activity during class recess or an additional class of structured outdoors activities after school led to a significant protective effect on myopia onset and myopic shift [17,18].
Thus, it becomes important to determine as to whether outdoor activities in day light act as protective factor for myopia progression in young people.

Method

This prospective, observational, single centered, hospital based study was conducted in the department of Ophthalmology of S. S. Medical College and associated GM Hospital, Rewa, (MP), between January 2019 and September 2020. All patients having any degree of myopia between the ages of 10 to 24 years (young people [19]) were included, while those having any corneal dystrophy or degeneration, astigmatism more than 2 diopters, keratoconus, any fundus abnormality other than myopic changes, any media opacity or history of any ocular surgery in the past were excluded.
Subjects who satisfied all inclusion criteria and met no exclusion criteria were enrolled in the study. Informed consent was taken. The purpose of study was explained to the subjects and their parents in cases of minors and confidentiality was assured. Data collected from all subjects included demographic characteristics like age, gender, residence, occupation and a detailed clinical history including the chief visual complaint, history of present illness, past history of ocular surgeries, any ocular trauma and wearing spectacles for vision correction and its changes.
A questionnaire survey was done about the amount of outdoor activity and the number of hours per day spent outdoors during daylight. The outdoor activity timing was grouped as 0 (no outdoor activity), 1-2 hours/day, 2-3 hours/day and >3 hours /day.
All study subjects underwent a comprehensive ophthalmic examination which included best corrected visual acuity assessment, anterior segment and posterior segment examination.
Cycloplegic refraction with cyclopentolate 1% in each eye 5 minutes apart was done for all patients followed by autorefration with Shin Nippon Autorefractometer after 30 minutes. Spherical equivalent (SE) was calculated for each eye separately by adding the sum of the sphere power with half of the cylinder power. Depending upon the degree of myopia, eyes were categorized as-
1. Group A: myopia $\leq$-3.00 diopters (low myopia)
2. Group B: myopia between -3.00 and -6.00 diopters (moderate myopia)
3. Group C: myopia $\geq$ -6.00 diopters (high myopia)

Patients were examined at the time of initial enrollment (Time 1) and twice thereafter, at six-month intervals (Time 2 and Time 3).
Progression of myopia was calculated as increase in myopic refraction of subject's eye between Time 1and Time 3.
The collected data was compiled using MS Excel and analyzed using IBM SPSS software version 20. Categorical data was expressed as frequency and percentage whereas numerical data was expressed as mean and standard deviation. Multivariate analysis was done to estimate the adjusted odds ratio for duration of outdoor activity in day light associated with myopia progression. p value less than 0.05 was considered statistically significant.

Result

The present study was conducted on 200 patients having varying degree of myopia. The age of the study subjects varied from a minimum of 10 years to a maximum of 24 years. There were 102 males and the male: female ratio was 1.04:1. Depending on the severity of myopia,101 (50.5%) eyes were categorized as low myopia,74 (37%) as moderate and 25 (12.5%) as high myopia.

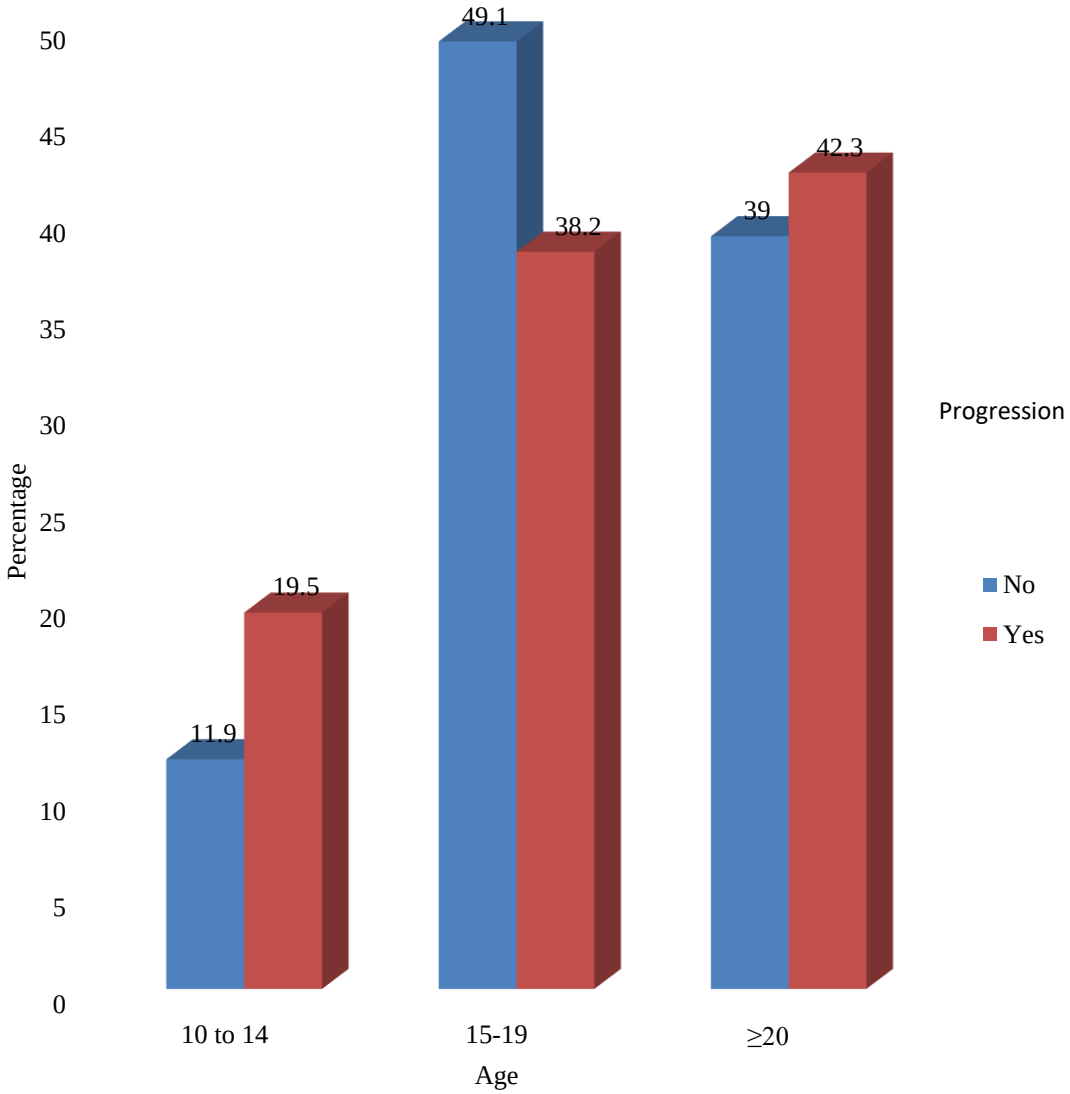
Mean age of patients whose eyes showed progression was 17.9±3.6 years whereas mean age of those with no progression was 18.5±3.3 years. Majority of eyes of patients with dioptric progression belonged to >20 years of

age (42.3%) whereas 49.1% cases with no progression belonged to 15 to 19 years of age. Odds ratio was significantly lower in patients belonging to age range of 15 to 19 years (OR=0.49, p=0.03). However, when we stratified the patients according to severity of myopia, no significant increase in odds of progression was noted in patients with different age group (p>0.05**). (Table 1 and figure 1)**

Table 1 -Association of progression of myopia with age

Myopia	**Age**	**Progression**		**OR (95% CI)**	**P value**
		No	**Yes**		
Low	10-14	13 (10.9)	9 (10.7)	-	
	15-19	64 (53.8)	37 (44)	0.77 (0.28-2.1)	0.61
	≥20	42 (35.3)	38 (45.2)	1.31 (0.4- 4.9)	0.7
	Mean	18.6±3.21	18.7±3.16		
Moderate	10-14	4 (12.5)	24 (20.7)	-	
	15-19	12 (37.5)	46 (39.7)	0.63 (0.17 – 2.33)	0.49
	≥20	16 (50)	46 (39.7)	1.39 (0.39- 2.49)	0.32
	Mean	18.1±3.54	17.5±3.6		
High	10-14	2 (25)	14 (34.1)	-	
	15-19	2 (25)	9 (22)	0.72 (0.13 – 2.44)	0.21
	≥20	4 (50)	18 (43.9)	1.09 (0.09- 2.09)	0.20
	Mean	18±2.9	17.4±4.1		
Total	10-14	19 (11.9)	47 (19.5)	-	
	15-19	78 (49.1)	92 (38.2)	0.48 (0.25- 0.92)	0.03
	≥20	62 (39)	102 (42.3)	0.57 (0.23-1.44)	0.24
	Mean	18.5±3.3	17.9±3.6		

Figure 1- Association of progression of myopia with age



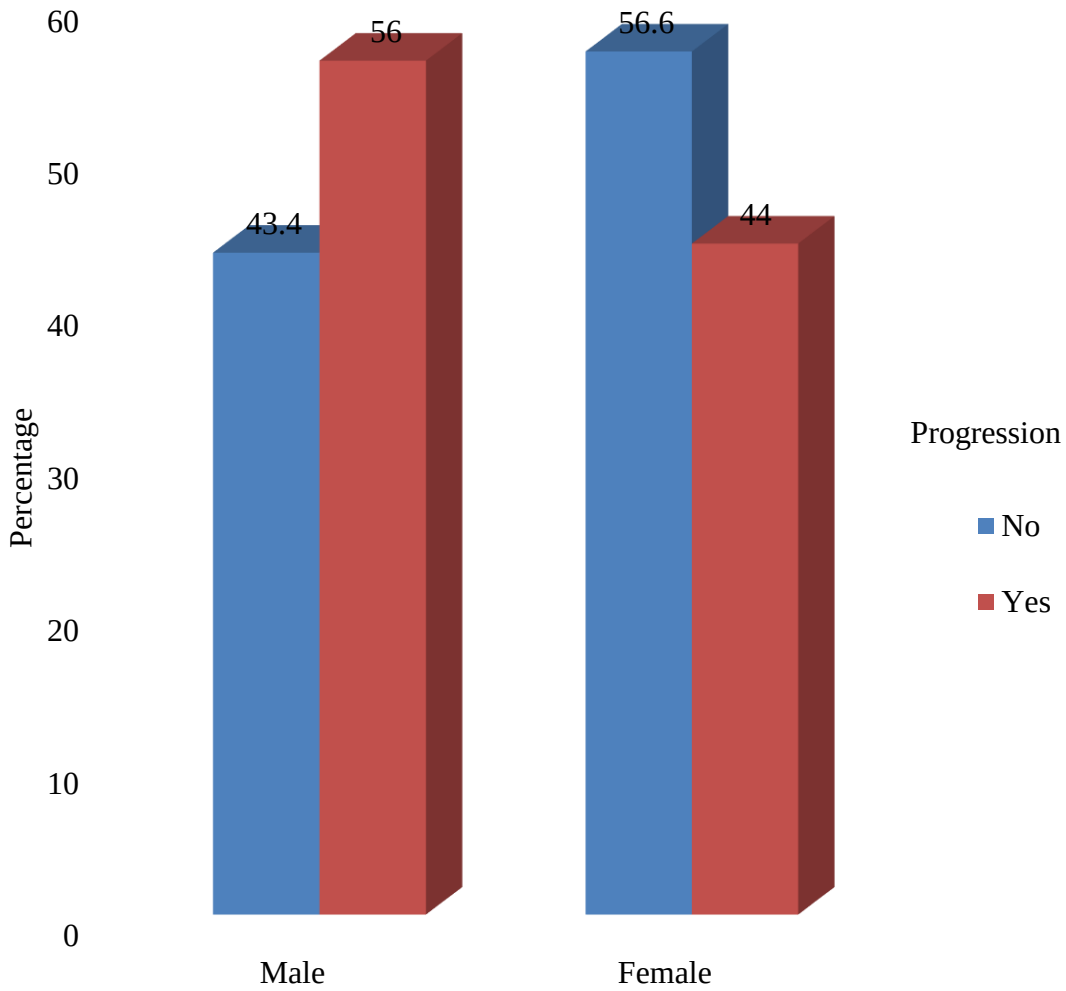
In the present study cohort, progression was observed in 56% eyes of males whereas 56.6% eyes with no progression were that of female patients. Our study documented no significant increase in odds of progression of myopia in males and females irrespective of severity of myopia (p>0.05). **(Table 2 and figure 2)**

Table 2- Association of progression of myopia with gender

Myopia	**Gender**	**Progression**		**OR (95% CI)**	**P value**
		No	**Yes**		
Low	Male	51 (42.9)	38 (45.2)	-	
	Female	68 (57.1)	46 (54.8)	1.03 (0.55-1.9)	0.93

Moderate	Male	12 (37.5)	62 (53.4)	-	
	Female	20 (62.5)	54 (46.6)	0.65 (0.26-1.66)	0.37
High	Male	6 (75)	35 (85.4)	-	
	Female	2 (25)	6 (14.6)	0.76 (0.21-2.98)	0.09
Total	Male	69 (43.4)	135 (56)	-	
	Female	90 (56.6)	106 (44)	0.68 (0.44-1.1)	0.09

Figure 2- Association of progression of myopia with gender

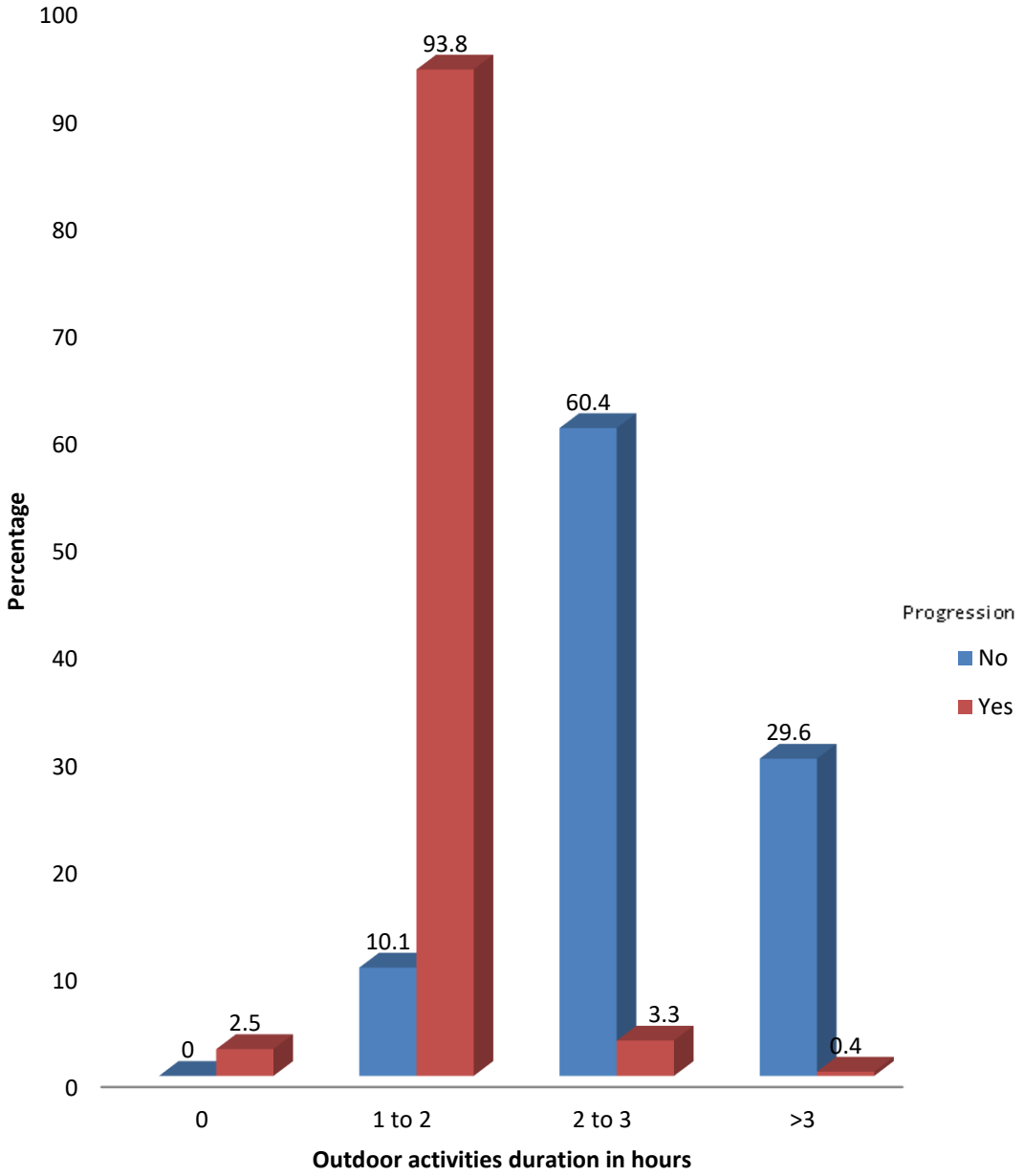


As regards outdoor activity, we found that the odds of myopia progression were significantly higher in patients engaged in outdoor activity for 1-2 hours as compared to those engaged in outdoor activity for longer hours ($p<0.05$) in all patients including low and high myopia. Means outdoor activities hours per day in overall myopic eyes showing progression was 1.4±0.6 while for eyes showing no progression of myopia it was 3.2±0.6.**(Table 3 and figure 3)**

Table 3- Association of progression of myopia with duration of outdoor activity in day light

Myopia	Outdoor activity(hours)	Progression		OR (95% CI)	P value
		No	Yes		
Low	0	0 (0)	2 (2.4)	1.2 (0.7-1.9)	0.067
	1-2	14 (11.8)	79 (94)	3.4 (1.3-4.4)	0.001
	2-3	72 (60.5)	2 (2.4)	1.2 (0.09-2.5)	0.89
	>3	33 (27.7)	1 (1.2)	-	
	Mean±SD	3.1±0.6	1.5±0.6		
Moderate	1-2	2 (6.2)	112 (96.6)	2.7 (1.16-3.15)	0.24
	2-3	20 (62.5)	4 (3.4)	0.56 (0.3-0.7)	0.69
	>3	10 (31.2)	0 (0)	-	
	Mean±SD	3.3±0.6	1.4±0.6		
High	0	0 (0)	4 (9.8)	1.23 (1.1-2.13)	0.49
	1-2	0 (0)	35 (85.4)	2.56 (1.4-3.4)	0.034
	2-3	4 (50)	2 (4.9)	0.39 (0.06-0.67)	0.78
	>3	4 (50)	0 (0)	-	
	Mean±SD	3.4±0.4	1.16±0.7		
Total	0	0 (0.0)	6 (2.5)	1.06 (0.47-1.75)	0.48
	1-2	16 (10.1)	226 (93.8)	2.95 (1.18-6.78)	0.001
	2-3	96 (60.4)	8 (3.3)	0.54 (0.07-0.98)	0.97
	>3	47 (29.6)	1 (0.4)	-	
	Mean±SD	3.2±0.6	1.4±0.6		

Figure 3- Association of progression of myopia with duration of outdoor activity in day light



Discussion

Myopia is a common ocular disorder seen in children and young adults and a cause of concern since it may progress to high myopia which is associated with increased risk of severe and irreversible loss of vision. By the year 2050, 49.8% of the world's population is expected to be suffering from myopia and 9.8% from high myopia

[1]. Therefore, it is important to identify the preventive and possible risk factors in the development and progression of myopia.

In the present study, mean age of patients with and without myopia progression was 17.9±3.6 and 18.5±3.3 years respectively but age was not observed to be a significant risk factor for myopia progression ($p>0.05$) in low, moderate as well as total cases. The findings of present study were contrasting to findings of **Jacobsen N et al** [20] in which on multivariate analysis, younger age ($P = 0.022$) was significantly associated with high risk of myopia progression. **Hyman L et al** [21] also documented younger age to be significantly associated with progression of myopia as compared to older children regardless of other baseline characteristics. A possible reason for this discrepancy in results could be attributed to differences in the study population group as well as the fact that our was hospital based study whereas their study was population based.

Though more patients of myopia were males, the progression of myopia was observed in equal proportion of males and females in our study. Risk of myopia progression was not significantly associated with gender in our study ($p>0.05$) irrespective of severity of myopia. In contrast to the present study, **Hyman L et al** [21] observed female gender to be significantly associated with higher odds of myopia progression as compared to males ($p<0.01$). A possible reason for this discrepancy in results could be attributed to differences in the study population group as well as the fact that our was hospital based study whereas their study was population based.

In our study cohort we found that engagement in outdoor activities and outdoor games in day light was associated with protective effect for myopia progression. The odds of progression (OR-2.95) were significantly higher in patients engaged in outdoor activities for 1-2 hours as compared to those engaged in outdoor activity for longer hours ($p<0.05$). The findings of present study were supported by findings of **Lin Z et al** [22] in which the authors documented a statistically significant association between outdoor activity time (in hours per day) and the children's spherical equivalent (in diopter) in the primary school students ($\beta = 0.27$, $p = 0.03$), but such association could not be observed in secondary school students ($\beta = 0.04$, $p = 0.70$). **Jin JX et al** [23] in their study also concluded that increasing outdoor activities are significantly helpful in preventing onset of myopia as well as has protective effect on axial growth of eyes .**Rusnak S et al** [24] also documented statistically significantly higher ($p<0.0001$) axial length growth which in turn is associated with myopia development and progression in children engaged in outdoor activities for less than 2 hours as compared to children engaged in outdoor activities for more hours.

Conclusion

To conclude from this study, we found that longer duration of outdoor activities in day light were associated with protective effect against myopia progression ($p<0.05$). The current findings suggest that by educating and instructing healthcare providers, children and their parents about increasing time spent outdoors in day light, prevention of myopia onset and its progression among young people may be possible.

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