International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(6): 1346-1352

Received: 19-09-2019
Accepted: 21-10-2019

Chaithu Sarakham Aimol
Regional Institute of Paramedical and Nursing Sciences, Zemabak, Aizawl, Mizoram, India

L Inaotombi Devi
Regional Institute of Paramedical and Nursing Sciences, Zemabak, Aizawl, Mizoram, India

Enghmingliani
Department of Opthalmology, Civil Hospital, Aizawl, Mizoram, India

Renee Lalrinzuali
Regional Institute of Paramedical and Nursing Sciences, Zemabak, Aizawl, Mizoram, India

Lalsanglura Ralte
Regional Institute of Paramedical and Nursing Sciences, Zemabak, Aizawl, Mizoram, India

Corresponding Author:
L Inaotombi Devi
Regional Institute of Paramedical and Nursing Sciences, Zemabak, Aizawl, Mizoram, India

Myopia prevalence in school children of Aizawl district of Mizoram and relationship with environmental factors

Chaithu Sarakham Aimol, L Inaotombi Devi, Enghmingliani, Renee Lalrinzuali and Lalsanglura Ralte

Abstract
Myopia may be caused by many factors like spending greater time looking at objects that are close, hereditary, environmental factors etc. Excessive close-up work, a high level of education, and participation in fewer outdoor activities were important environmental risk factors for myopia. Parental myopia has a significant effect on the development and progression of pediatric myopia. In the present investigation an attempt was made to correlate the myopic prevalence rate with some environmental factors like time spent on outdoor activity, time spent on electronic devises, effect of parent's eye sight and economic status of the family.

Keywords: Myopia, Aizawl, indoor-outdoor activity on myopia, electronic devises and myopia, eye sight of parents on myopia

Introduction
Myopia or short sightedness is a correctable visual impairment and preventable blindness worldwide (Belete *et al*., 2017) [1]. It is one of the most common ocular disorders seen in children and young adults and is a cause of concern world-over (Resnifoff *et al*., 2008; Morgan *et al*., 2012; Pan *et al*., 2012; Wu *et al*., 2016 Saxena *et al*., 2017) [2-6]. Globally, the prevalence rate among the older teenager is approximately 20%-35% (Belete *et al*., 2017) [1]. A study by Saxena and his associates had reported a prevalence of only 13.1% among school children in India (Saxena *et al*., 2015) [7]. However, this is higher than most previous reports from India (Dandona *et al*., 2002; Murthy *et al*., 2002; Saxena *et al*., 2017) [8, 9, 6].
The cause for myopia may be because of many factors (Morgan *et al*., 2012) [3] like spending greater time looking at objects that are close, hereditary, environmental factors etc. Both genetics and the environment play a role in the development and progression of myopia. Many epidemiological surveys have shown that excessive close-up work, a high level of education and participation in fewer outdoor activities were important environmental risk factors for myopia (Wu *et al*., 2001; Huang *et al*., 2015; Ip *et al*., 2008; Rose *et al*., 2008; Jung *et al*., 2012; Williams *et al*., 2015) [10-15]. Increase amount of time spent outdoors in sunlight has been shown to reduce myopia prevalence rates possibly due to release of dopamine from the retina on exposure to light (Rose *et al*, 2008; Ashby *et al*, 2009) [13, 16]. More prevalence of myopia among the children of those myopic parents was reported by many workers (Belete *et al*., 2017; Khader *et al*., 2006; You *et al*., 2012; Konstantopoulos *et al*., 2008) [1, 17-19]. Parental myopia has a significant effect on the development and progression of pediatric myopia (Kurtz *et al*., 2007; Mutti *et al*., 2002; Hui *et al*., 1995; Wu *et al*., 1999; Saw *et al*., 2001) [20-23]. The effects of having two myopic parents were significantly higher than those for children with one or no myopic parents (Zhang *et al*., 2017; Hui *et al*., 1995) [25, 22]. There are also some conflicting reports on relationship between the prevalence of myopia and economic status of the subjects. A study in Delhi reported that children in the upper-middle socioeconomic status had a slightly higher risk of myopia (Saxena *et al*., 2015) [7]. In the present investigation an attempt was made to correlate the myopic prevalence rate with some environmental factors like time spent on outdoor activity, time spent on electronic devises, effect of parent's eye sight and economic status of the family.

Materials and Methods

The study was conducted on school going students from 7 schools and hospitals in Aizawl district of Mizoram during 2014-2017, who was examined to determine the prevalence of myopia. The vision of the child was documented by the optometrist. Children with sub-normal visual acuity i.e. those unable to read the 6/9p line on the Snellen chart and those children having previous myopic glasses were further examined by an optometrist for confirmation of vision and refraction if required. Retinoscopy was done using a streak retinoscope (Heine BETA 200) and a modern automated refractor (Matronix Q30+ Korea). The autorefractor was calibrated at the beginning of each working day and a single reading was taken for each eye. The final prescription was based on the subjective refraction. All those children who had normal unaided presenting vision in the first round but failed to read the 6/9p line on the Snellen chart were the new cases of refractive error and were evaluated for identifying cases with myopic refractive error to determine the incidence of myopia. The data analysis was carried out using the SPSS (SPSS. 2001) [23] statistical package for social science.

For all students a structured questionnaire regarding risk factors was filled. The questions were asked in Mizo which is understood by all the children and parents and the answers were recorded in English. The questionnaire was filled by asking the details from the child and one or both parents. For collecting data on the hours spent in the various activities the actual total time spent for the activity in school and at home was recorded. The question on hours spent outdoor was aimed to capture the entire time spent outdoors and not just for sports and recreational activities. The data analysis was carried out using the SPSS (SPSS. 2001) [27] statistical package for social science.

Result and Discussion

The prevalence rate of myopia among the school going students in Aizawl district of Mizoram in the age group of 13-19 years was 51.90%. The prevalence of non-myopia, mild myopia, moderate myopia and high myopia observed were 48.5%, 48%, 3.5% and 0.3% respectively. In the present investigation, there was strong association between the prevalence of myopia and duration of using the electronic devises. It was observed that among the students in the age group of 13 to 15 years of age, the prevalence rate of mild myopia was 93.81% and the remaining 6.18% was moderate myopia. The incidence of mild myopic condition significantly (p<0.01) increased with increased in time of usage of the electronic devises.

Table 1: Relation between the prevalence of myopia with duration of using electronic devices among the school going Mizo students within the age group of 13-15 years

Myopia status	Sex (Male/Female)	Duration of using the Electronic devices		Total
		≤2 hrs	>2 hrs	
Non Myopia	Male	42.30et al66)	57.69(90)	156**
	Female	61.72(100)	38.27(62)	162 **
	Total	52.20**(166)	47.79**(152)	51.46(318)
Mild Myopia	Male	32.28(41)	67.71(86)	127 **
	Female	40.37(65)	59.62(96)	161**
	Total	36.80 **(106)	63.19 ^{NS}(182)	46.60(288)
Moderate Myopia	Male	0	100(4)	4 **
	Female	0	100(8)	8**
	Total	0	100^{NS}(12)	1.94(12)
High Myopia	Male	0	0	0
	Female	0	0	0
	Total	0	0	0
Grand total				618

* Significant for p≥0.05, ** significant for p≥0.01, NS = Non significant

The prevalence among those who use less than 2 hrs or less was 36.80% and this significantly (p<0.01) increase to 63.19% among those who use more than 2 hrs. The moderate myopia was observed only among those who use the electronic devises for more than 2 hrs. The relationship between the prevalence of myopia and duration of use of electronic devises in the age group of 13-15 years is given in Table 1. In the age group of 16 to 19 years, the rate of mild myopia among the myopic students was 91.00%. The moderate myopia and high myopia was 7.70% and 0.80% respectively. The increase use of the electronic devises significantly increase (p<0.01) the myopic condition of the students as was observed in the age group of 13-15 years. The relationship between the prevalence of myopia and duration of use of electronic devises in the age group of 16-19 years is given in Table 2.

Table 2: Relation between the prevalence of myopia with duration of using electronic devices among the school going Mizo students within the age group of 16-19 years.

Non-Myopia	**Male**	**46.24 (117)**	**53.75 (136)**	**253^{NS}**
	Female	45.78(114)	54.21(135)	249*
	Total	46.01^{NS} (231)	52.11^{NS} (271)	46.22(502)
Mild Myopia	Male	45.70(149)	54.29(177)	326*
	Female	30.76(64)	69.23(144)	208*
	Total	39.88 **(213)	60.11**(321)	49.17 (534)
Moderate Myopia	Male	40.00(8)	60.00(12)	20^{NS}
	Female	40.00(10)	60.00(15)	25^{NS}
	Total	40.00^{NS} (18)	60.00 ^{NS} (27)	4.14(45)
High Myopia	Male	00	100(01)	01*
	Female	50.00(02)	50.00(02)	04^{NS}

	Total	40.00*(02)	60.00^{NS} (03)	0.46(05)
Grand total				1086

* Significant for p≥0.05, ** significant for p≥0.01, NS = Non significant

The observed prevalence of mild myopia among those who use less than 2 hrs or less was 39.89% and this significantly increase (p<0.01) to 60.11% among those who use more than 2 hrs. A similar trend was also observed for moderate myopia. The percentage of prevalence among those who use less than 2 hrs or less was 40.00% and this increase to 60.00% among those who use more than 2 hrs. A significance relationship in the prevalence of myopia and duration of use of electronic devises was also observed among the non-Mizo students. The relationship between the prevalence of myopia and duration of use of electronic devises among the non-Mizo students is given in Table 3. Among those myopic persons, 86.08% was mild myopic, 11.39 was moderate myopic and 2.53% was high myopic. The percentage of prevalence among those who use less than 2 hrs or less was 41.17 and this increases significantly (p<0.01) to 58.82% among those who use more than 2 hrs.

Table 3: Relation between the prevalence of myopia with duration of using electronic devices among the school going non-Mizo students

Myopia status	Sex (Male/Female)	Duration of using the Electronic devices		Total
		≤2 hrs	>2 hrs	
Non Myopia	Male	55.55(15)	12(44.44)	27^{NS}
	Female	65.90(29)	34.09(15)	44**
	Total	61.97**(44)	38.02^{NS}(27)	47.33(71)
Mild Myopia	Male	39.53(17)	60.46(26)	43*
	Female	44.00(11)	56.00(14)	25^{NS}
	Total	41.17 **(28)	58.82**(40)	45.33(68)
Moderate Myopia	Male	50.00(01)	50.00(01)	02^{NS}
	Female	42.85(03)	4(57.14)	07^{NS}
	Total	4(44.44) ^{NS}	5(55.55) *	9 (6.00) ^{NS}
High Myopia	Male	0	100(01)	01**
	Female	0	100(01)	01*
	Total	0	100^{NS}(02)	1.33(02)
Grand total				150

* Significant for p≥0.05, ** significant for p≥0.01,NS = Non significant

Similar findings of higher prevalence of myopia among the students who use electronic devises for longer duration compared to those who use less is also reported by many workers (Kotha *et al*., 2018; Demissie *et al*., 2010; Ip *et al*., 2008; Saxena *et al*., 2015; Gou *et al*., 2016; Saw *et al*., 2002) [27, 28, 12, 7, 29, 30].

The prevalence of myopia and individual's indoor or outdoor activity is also closely related. The incidence of mild myopic condition was significantly (p<0.01) higher for those whose activities were mostly confined in indoor activities. Among the age group of 13-15 years, it was observed that 70.14% of the mild myopic students were confined mostly in indoor activities while 29.86% students were involved more in outdoor activities. All the moderate myopic conditions were observed among those whose activity is mostly confined to indoor activities. Table 4 present the relationship between the prevalence of myopia and time spent indoor or outdoor activities in the age group of 13-15 years. Similar observation was made for the age group of 16-19 years. The prevalence of the mild, moderate and high myopic conditions observed among the myopic students was respectively 91.44%, 7.71% and 0.86%s. Among the mild myopic persons, 69.47% was confined mostly in indoor activities while 30.52% are involved in more outdoor activities. Among the moderate myopic persons 68.89% are confined mostly in indoor activities while 31.11% are involved in outdoor activities. Table 5 present the relationship between the prevalence of myopia and time spent indoor or outdoor activities in the age group of 16-19 years.

Table 4: Relation between the prevalence of myopia with place of activity among the school going Mizo students within the age group of 13-15 years

Myopia status	Sex (Male/Female)	Place of activity		Total
		Indoor	Outdoor	
Non Myopia	Male	51.28(80)	48.71(76)	156**
	Female	21.60(35)	78.39(127)	162**
	Total	36.16**(115)	63.83**(203)	318(51.46)
Mild Myopia	Male	62.20(79)	37.79(48)	127**
	Female	76.39(123)	23.60(38)	161**
	Total	70.13**(202)	29.86 **(86)	46.60(288)
Moderate Myopia	Male	100(04)	0	4**
	Female	100(08)	0	8**
	Total	100^{NS}(12)	0	12(1.94)
High Myopia	Male	0	0	0
	Female	0	0	0
	Total	0	0	0
Grand total				618

* Significant for p≥0.05, ** significant for p≥0.01,NS = Non significant

Table 5: Relation between the prevalence of myopia with place of activity among the school going Mizo students within the age group of 16-19 years

Myopia status	Sex (Male/Female)	Place of activity		Total
		Indoor	Outdoor	
Non Myopia	Male	33.99(86)	66.00(167)	253**
	Female	42.16(105)	57.83(144)	249**
	Total	38.04*(191)	61.95**(311)	46.22(502)
Mild Myopia	Male	67.79(221)	32.20(105)	326**
	Female	72.11(150)	27.88(58)	208**
	Total	69.47**(371)	30.52 **(163)	49.17(534)
Moderate Myopia	Male	80.00(16)	20.00(04)	20**
	Female	60.00(15)	40.00(10)	25^{NS}
	Total	68.88^{NS}(31)	31.11**(14)	4.14(45)
High Myopia	Male	100(01)	0	01*
	Female	50(02)	50.00(02)	04^{NS}
	Total	60.00^{NS}(03)	40.00*(02)	0.46(05)
Grand total				1086

* Significant for p≥0.05, ** significant for p≥0.01, NS = Non-significant

As observed among the Mizo students, the prevalence of the myopia among the non-Mizo students also significantly increase (p<0.01) with more indoor activity of the persons. Table 6 present the relationship between the prevalence of myopia and time spent indoor or outdoor activities among the non-Mizo students. The prevalence of the mild, moderate and high myopic conditions within the myopic persons observed were respectively 86.07%, 11.39% and 2.53%. Among the mild myopic persons 64.71% were confined mostly in indoor activities while 35.29% was involved in outdoor activities.

Table 6: Relation between the prevalence of myopia with place of activity among the school going non-Mizo students

Myopia status	Sex (Male/Female)	Place of activity		Total
		Indoor	Outdoor	
Non-Myopia	Male	51.85 (14)	48.14(13)	27^{NS}
	Female	43.18 (19)	56.81(25)	44^{NS}
	Total	46.47^{NS} (33)	53.52**(38)	47.33(71)
Mild Myopia	Male	58.13 (25)	41.86(18)	43^{NS}
	Female	76.00 (19)	24.00(06)	25**
	Total	64.70^{NS} (44)	35.29**(24)	45.33(68)
Moderate Myopia	Male	50(01)	50(01)	2^{NS}
	Female	71.42(05)	28.57(02)	7^{NS}
	Total	66.66 *(06)	33.33^{NS}(03)	6.00(09)
High Myopia	Male	100(01)	0	1^{NS}
	Female	100(01)	0	1^{NS}
	Total	100^{NS}(02)	0	1.33(02)
Grand total				150

* Significant for p≥0.05, ** significant for p≥0.01,NS = Non significant

The observation in case of moderate myopia was also similar to that of mild myopia. Among the moderate myopia persons 66.66% was confined mostly in indoor activities while 33.34% was involved in outdoor activities. The more prevalence of myopia for those whose activity is confined mainly in indoor activity is also reported by other workers (Jones *et al*., 2007; Rose *et al*., 2008; Saxena *et al*., 2015; Ashby *et al*, 2009; Belete *et al*., 2017) [31, 13, 7, 16, 1]. Studies in china and Singapore found children with myopia spent more hours in reading per day, and a higher proportion used computers regularly (Demissie et al., 2010) [28]. In another study at USA, students engaged in reading both school work at home and pleasure reading is positively correlated with myopia however, in same study watching TV and playing electronic gadgets were negatively correlated (Ip *et al*., 2008) [12]. Saxena and his associates (2015) [7] evaluated the effect of behavioral (modifiable) risk factors on myopia. The results show that near related activity such as study/reading > 5 hours in day, watching television > 2 hours / day and playing computer/video/mobile games increased the risk of developing myopia. This might be as a result of subjects who spent more time for near work are at higher risk of inherent ciliary spasm that in turn will lead to defocused retinal image and myopia development. Gou and associates (2016) [29] evaluated the amount of time spent for reading or studying for school assignments, reading for pleasure, watching television, using computer, and playing electronics, but also assessed the reading distance and the distance to the television set among primary and middle school-aged students in Guangzhou, South China and demonstrated that children with myopia spent more time engaged in reading or studying for school assignments daily, reading for pleasure daily, using computer weekly, watching television weekly, and playing electronics weekly, compared with children without myopia (P<0.05). Similarly, Saw's study (Saw *et al*., 2002) [30] in Singapore and China found that compared with children without myopia, myopic children spent more hours in reading per day, and a higher proportion of myopic children used the computer regularly (P<0.05. Saxena *et al*. (2015) [7] illustrated that positive association of myopia was observed with children study/reading more than 5 h per day, watching television more than 2 h per day, and playing computer/video games.

In the present investigation, a correlation between the prevalence of myopia of the students with defective eye sight of the parents was also observed. In the age group of 13-15 years of the Mizo students, the prevalence of myopia for those

whose parents have defective eye sights were non-significantly higher than for those whose parents do not have defective eye sights. Table 7 shows the relationship between the prevalence of myopia and condition of parent's eye sight of the Mizo students in the age group of 13-15 years.

Table 7: Relation between the prevalence of myopia among the school going Mizo students with their parents wearing glass within the age group of 13-15 years

Myopia status	Sex (Male/Female)	Status of Parents		Total
		Defective	Non- Defective	
Non-Myopia	Male	0	100(156)	156**
	Female	22.22(36)	77.77(126)	162**
	Total	11.32**(36)	88.67* (282)	51.45(318)
Mild Myopia	Male	52.75(67)	47.24(60)	127^{NS}
	Female	50.31(81)	49.68(80)	161^{NS}
	Total	51.38^{NS}(148)	48.61 * (140)	46.60(288)
Moderate Myopia	Male	100(4)	0	4**
	Female	50(4)	50(4)	8^{NS}
	Total	66.66^{NS}(8)	33.33 **(4)	1.94(12)
High Myopia	Male	0	0	0
	Female	0	0	0
	Total	0	0	0
Grand total				618

* Significant for $p \geq 0.05$, ** significant for $p \geq 0.01$,NS = Non significant

The myopia observed for the persons with their parents having eye sight problems was 52.00% while for those with parents without the eye sight problems was 48%. In the age group of 16 to 19 years the observed myopia significantly increased ($p<0.01$) for those whose parents were wearing glasses. Table 8 shows the relationship between the prevalence of myopia and condition of parents eye sight of the Mizo students in the age group of 13-15 years. Among the mild myopic students, 60.86% of the students were those whose parents have defective eye sights while 39.13% students are those whose parents do not have eye defects.

Table 8: Relation between the prevalence of myopia among the school going Mizo students with their parents wearing glass within the age group of 16-19 years

Myopia status	Sex (Male/Female)	Status of Parents		Total
		Defective	Non- Defective	
Non-Myopia	Male	32.01(81)	67.98(172)	253**
	Female	24.49(61)	75.50(188)	249**
	Total	28.28* (142)	71.71^{NS}(360)	46.22(502)
Mild Myopia	Male	64.41(210)	35.58(116)	326**
	Female	55.29(115)	44.71(93)	208*
	Total	60.86* (325)	39.13* (209)	49.17(534)
Moderate Myopia	Male	60.00(12)	40.00(8)	20^{NS}
	Female	64.00(16)	36.00(9)	25*
	Total	62.22^{NS} (28)	37.77^{NS}(17)	4.14(45)
Hyper Myopia	Male	100(1)	0	1*
	Female	100(4)	0	4**
	Total	100* (5)	0	0.46(5)
Grand total				1086

* Significant for $p \geq 0.05$, ** significant for $p \geq 0.01$,NS = Non significant

The prevalence of moderate myopia is also more for those whose parents have defective eye sights. Similar to Mizo students, the prevalence of myopia in non-Mizo students was also higher whose parents have defective eye sights.

Table 9: Relation between the prevalence of myopia among the school going non-Mizo students with their parents wearing glass

Myopia status	Sex (Male/Female)	Status of Parents		Total
		Defective	Non- Defective	
Non-Myopia	Male	29.62(8)	70.37 (19)	27**
	Female	34.09 (15)	65.90 (29)	44**
	Total	32.39 *(23)	67.60 *(48)	47.33 (71)
Mild Myopia	Male	74.41 (32)	25.58 (11)	43**
	Female	60.00 (15)	40.00 (10)	25^{NS}
	Total	69.11 ** (47)	32.35^{NS}(22)	45.33 (68)
Moderate Myopia	Male	100 (2)	0	2*
	Female	71.42 (5)	28.57 (2)	7^{NS}
	Total	77.77^{NS}(7)	22.22*(2)	6.00(9)
Hyper Myopia	Male	100 (1)	0	1*
	Female	100 (1)	0	1*
	Total	100.00^{NS}(2)	0	1.33 (2)

Grand total	150

Significant for p≥0.05, ** significant for p≥0.01,NS = Non significant

The prevalence of mild myopia for those whose parents have defective eye sights was 69.11% while for those students whose parents do not have eye defects was 32.35%. Table 9 shows the relationship between the prevalence of myopia and condition of parents eye sight of the Mizo students in the age group of 13-15 years. More prevalence of myopia among the children of those myopic parents is reported by many workers (Belete *et al*., 2017; Khader *et al*., 2006; You *et al*., 2012; Konstantopoulos *et al*., 2008) [1, 17-19]. Several studies have shown that parental myopia has a significant effect on the development and progression of pediatric myopia (Kurtz *et al*., 2007; Mutti *et al*., 2002; Hui *et al*., 1995; Wu *et al*., 1999; Saw *et al*., 2001) [20-24]. In particular, the effects of having two myopic parents were significantly higher than those for children with one or no myopic parents (Zhang *et al*., 2017; Hui *et al*., 1995) [25, 22]. Belete and associates (2017) [1] also found that myopia was more prevalent in children with positive family history of myopia and higher socio-economic status in their study on prevalence and associated factors of myopia among high school students in Gondar town, northwest Ethopia in 2016. The study participants who had positive family history of myopia were 8 times more likely to develop myopia as compared to those who had no family history of myopia. Studies conducted in Amman city, Beijing, and Greece was also in agreement with the finding that myopia was more prevalent in children with positive family history of myopia (Khader *et al*., 2006; You *et al*.; Konstantopoulos *et al*., 2008) [17-19]. Guo *et al*. (2016) [29] demonstrated that there was a trend for higher myopia prevalence among children with a parental myopia history.

The prevalence of myopic condition of the Mizo students in the age group of 13-15 years was significantly highest among the middle income group ($p<0.05$) and the least was among the rich economic family background. For the students from poor family background, myopic condition was observed among 42.85% and all these were mild myopia. In the middle class family background, myopic condition was observed among 53.47% while 46.53% was non-myopia. Among the students from rich family background, myopic condition was observed among 36.95. In the age group of 16-19 years, the students from poor family background, myopic condition was observed in 32.37% while in middle class family background, myopia condition was observed in 57.56% and within the rich family background, myopia condition was observed among 63.36%. Thus the prevalence of myopia was more for those students with better economic condition. In the non-Mizo students the highest prevalence of myopia was observed in the students from middle economic class. Among the students from poor family background, the observed myopia was 21.75% while in middle and rich background students, the prevalence rates 60.43% and 52.77%. The present finding is in agreement with the finding of Saxena et al., 2015 [7]. A prior study in Delhi reported that children in the upper-middle socioeconomic status had a slightly higher risk of myopia (Saxena et al., 2015) [7]. The more prevalence of myopia for the students from better economic status (middle and rich family background) may be because of the fact that the duration of using the electronic devises like smartphones, watching television by these students will be more compared to the students from the poor family background. Further, the time spent by the students from the better family background in indoor activity is likely to be more.

References

1. Belete AA, Anbesse DH, Tsegaye AT, Hussen MS. Prevalence and associated factors of myopia among high school students in Gondar town, northwest Ethiopia, Clin Optom (Auckl). Published online. 2016; 9:11-18. Dec 23. doi: 10.2147/OPTO.S120485.
2. Resnikoff S, Pascolini D, Mariotti SP, Pokharel GP. Global magnitude of visual impairment caused by uncorrected refractive errors in 2004. Bull World Health Organ. 2008; 86:63-70.
3. Morgan IG, Ohno-Matsui K, Saw SM. Myopia. Lancet. 2012; 379:1739-1748.
4. Pan CW, Ramamurthy D, Saw SM. Worldwide prevalence and risk factors for myopia. Ophthalmic & Physiological Optics. 2012; 32(1):3-16.
5. Wu PC, Huang HM, Yu HJ, Fang PC, Chen CT. Epidemiology of Myopia. Asia Pac J Ophthalmol. 2016; 5:386-393.
6. Saxena R, Vashist P, Tandon R, Pandey RM, Bhardawaj A *et al*. Incidence and progression of myopia and associated factors in urban school children in Delhi: The North India Myopia Study (NIM Study). PLoS ONE. 2017; 12(12): e0189774.https://doi.org/10.1371/journal.pone.01897747.
7. Saxena R, Vashist P, Tandon R, Pandey RM, Bhardawaj A, Menon V *et al*. Prevalence of Myopia and Its Risk Factors in Urban School Children in Delhi: The North India Myopia Study (NIM Study). PLoS ONE. 2015; 10(2): e0117349. https://doi.org/10.1371/journal.pone.0117349
8. Dandona R, Dandona L, Srinivas M, Sahare P, Narsaiah S, Muñoz SR *et al*. Refractive error in children in a rural population in India. Invest Ophthalmol Vis Sci. 2002; 43:615-622.
9. Murthy GV, Gupta SK, Ellwein LB, Muñoz SR, Pokharel GP, Sanga L *et al*. Refractive error in children in an urban population in New Delhi. Invest Ophthalmol Vis Sci. 2002; 43:623-631.
10. Wu HM, Seet B, Yap EP, Saw SM, Lim TH, Chia KS. Does education explain ethnic differences in myopia prevalence? A population-based study of young adult males in Singapore. Optom Vis Sci. 2001; 78:234-239.
11. Huang HM, Chang DS, Wu PC. The Association between Near Work Activities and Myopia in Children-A Systematic Review and Meta-Analysis. PLOS One. 2015; 10(10):e0140419.
12. Ip JM, Saw SM, Rose KA, Morgan IG, Kifley A, Wang JJ *et al*. Role of near work in myopia: findings in a sample of Australian school children. Invest Ophthalmol Vis Sci. 2008; 49(7):2903-2910.
13. Rose KA, Morgan IG, Ip J, Kifley A, Huynh S, Smith W *et al*. Outdoor activity reduces the prevalence of myopia in children. Ophthalmology. 2008; 115:1279-1285.
14. Jung SK, Lee JH, Kakizaki H, Jee D. Prevalence of myopia and its association with body stature and educational level in 19-year-old male conscripts in Seoul, South Korea. Invest Ophthalmol Vis Sci. 2012; 53(9):5579-5583.
15. Williams KM, Bertelsen G, Cumberland P, Wolfram C, Verhoeven VJ, Anastasopoulos E *et al*. Increasing Prevalence of Myopia in Europe and the Impact of Education. Ophthalmology. 2015; 122(7):1489-1497.

16. Ashby R, Ohlendorf A, Schaeffel F. The effect of ambient illuminance on the development of deprivation myopia in chicks. Invest Ophthalmol Vis Sci. 2009; 50:5348-5354.
17. Khader YS, Batayha WQ, Abdul-Aziz SM, Al-Shiekh Khalil MI. Prevalence and risk indicators of myopia among schoolchildren in Amman, Jordan. East Mediterr Health J. 2006; 12(3-4):434-439.
18. You QS, Wu LJ, Duan JL, Luo YX, Liu LJ, Li X *et al*. Factors associated with myopia in school children in China: the Beijing childhood eye study. PLoS One. 2012; 7:e52668 10.1371.
19. Konstantopoulos A, Yadegarfar G, Elgohary M. Near work, education, family history, and myopia in Greek conscripts. Eye (Lond). 2008; 22(4):542-546.
20. Kurtz D, Hyman L, Gwiazda JE, Manny R, Dong LM, Wang Y *et al*. Role of parental myopia in the progression of myopia and its interaction with treatment in COMET children. Invest Ophthalmol Vis Sci. 2007; 48:562-750.
21. Mutti DO, Mitchell GL, Moeschberger ML, Jones LA, Zadnik K. Parental myopia, near work, school achievement, and children's refractive error. Invest Ophthalmol Vis Sci., 2002; 43:3633-3640.
22. Hui J, Peck L, Howland HC. Correlations between familial refractive error and children's noncycloplegic refractions. Vision Res. 1995; 35:1353-1358.
23. Wu MM, Edwards MH. The effect of having myopic parents: an analysis of myopia in three generations. Optom Vis Sci. 1999; 76:387-392.
24. Saw SM, Nieto FJ, Katz J, Schein OD, Levy B, Chew SJ. Familial clustering and myopia progression in Singapore school children. Ophthalmic Epidemiol. 2001; 8:227-236.
25. Zhang D, Zeng G, Hu J, McCormick K, Shi Y, Gong B. Association of IGF1 polymorphism rs6214 with high myopia: A systematic review and meta-analysis. Ophthalmic Genet. 2017; 38:434-439.
26. SPSS. Statistical Package for Social Sciences. SPSS Inc., 444 Michigan Avenue, Chicago, IL 60611, 2001.
27. Kotha A, Mohammed M, Mohammed S. A study on prevalence of myopia and causative factors among primary and middle school students in Hyderabad, India. International Journal of Medical Science and Innovative Research. 2018; 3(6):295-303
28. Demissie Z, Lowry R, Eaton DK, Park S, Kann L. Electronic media and beverage intake among United States high school students-2010. J Nutr Educ Behav. 2013; 45(6):756–760.
29. Gou L, Yang J, Mai J, Du X, Gou Y, Li P *et al*. Prevalence and associated factors of myopia among primary and middle school-aged students: a school-based study in Guangzhou. Eye (Lond). 2016; 30(6):796-804.
30. Saw SM, Gazzard G, Au-Eong KG, Tan DT, Gazzard Au Eong, Tan. Myopia: attempts to arrest progression. Br J Ophthalmol. 2002; 86(11):1306-1311.
31. Jones LA, Sinnott LT, Mutti DO, Mitchell GL, Moeschberger ML, Zadnik K. Parental history of myopia, sports and outdoor activities, and future myopia. Invest Ophthalmol Vis Sci. 2007; 48(8):3524-3532.