Original Article

Visual impairment among 10–14-year school children in Puducherry: A cross-sectional study

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Abstract

Introduction: According to the 2010 estimates by the World Health Organization, nearly 285 million (4.24% of total population) people of all ages worldwide are visually impaired. Almost 18.9 million children under 15 years of age are visually impaired globally. In developing countries, 7%–31% of childhood blindness and visual impairment is avoidable. **Materials and Methods:** The study was conducted as a cross-sectional study among 1884 school students in Puducherry, in the age group of 10–14 years. A child with presenting maximum vision ≤6/12 Snellen equivalent in the better eye is considered visually impaired. Data were entered in Microsoft Excel 2013 and analyzed using the statistical software SPSS version 21.0. Chi-square test was applied for testing difference in proportion and a $P < 0.05$ was considered statistically significant. **Results:** The overall prevalence of visual impairment (vision ≤6/12) among the study participants was 6.37% (95% confidence interval = 5.27–7.47). The prevalence of visual impairment increased with age and it was found to be high among male students (6.6%) when compared to female students (6%). Presenting vision of 6/6 was observed in 79.8% of the children while with pinhole correction, the proportion increased to 94.6%. **Conclusion:** The prevalence of visual impairment in our study population was found to be 6.37% and the prevalence was even higher among children who belonged to schools of urban region or private schools. Children with a positive family history of spectacle use were more likely to have visual impairment.

Keywords: Myopia, refractive error, school children, visual impairment

Introduction

According to the 2010 estimates by the World Health Organization (WHO), nearly 285 million (4.24% of total population) people of all ages worldwide are visually impaired and 39 million are blind. Furthermore, 90% of world's visually impaired live in developing countries and 21.9% of the world's visually impaired are in India. Almost 18.9 million children under 15 years of age are visually impaired globally.[1] In developing countries, 7%–31% of childhood blindness and visual impairment is avoidable, 10%–58% is treatable, and 3% to 28% is preventable.[2] Less developed countries have more avoidable causes of visual impairment compared to the unavoidable congenital causes in developed countries.[3-6] Myopia being the most common cause of visual impairment among children, its prevalence is found to be high among children of Asian origin.[7] Visual acuity <6/18 is considered visual impairment among adults; however, for children, the WHO recommends binocular vision ≤6/12 is considered statistically significant. The WHO also recommends the priority age group for vision screening as 11–15 years.[8] As on 2004, 1.6 million children in the age group of 5–15 years are visually impaired due to uncorrected refractive error.[9] It is estimated that there were 1.7 billion myopes in 2010

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and by the year 2020, there will be 2.2 billion.[10] The resources and infrastructure for eye care services in India are much below the actual requirement. Estimated average coverage of refractive services for the age group 5–15 years for rural areas in India is 30% (which is the lowest of all regions of WHO) and it is 55% for urban areas. Furthermore, high proportion of people who could have benefited from eye care services were not using the available services.[11] Blind or visually impaired children are economically unproductive and they also consume 10% of the time of an economically productive member of their family. I$ 269 billion (GDP) each year is the global cost in "lost productivity" on account of avoidable distant vision impairment and for the Southeast Asian region, it is I$ 44.5 billion.[12] In 1995, the WHO launched Global School Health Initiative to improve health status of the students.[13] The WHO recommends screening for vision problems and providing refractive services to children at school along with other health issues.[8] School eye screening program was introduced under NPCB in 1994 in India. Despite the importance of uncorrected refractive error as a cause of visual disability in children, little published research in India has focused on exploring the possible risk factors for refractive error. Furthermore, data on prevalence, distribution, and determinants of refractive error are needed to plan and provide better eye care services so as to reduce visual impairment among children. The present study was carried out to measure the prevalence of visual impairment among 10–14-year-old school students in Puducherry, South India.

Materials and Methods

The study was conducted as a cross-sectional study in Puducherry, a union territory in South India, among 1884 school children belonging to the age group of 10–14 years. The study was conducted during January 2014 to October 2015. The minimum required sample size was calculated to be 1463 based on the prevalence of visual impairment (≤6/12) of 6.4%,[14] with the relative precision of 20%. There are 173 high and higher secondary schools in Puducherry, of which 100 are in urban areas and 73 are in rural areas. Out of 173 schools in Puducherry,[15] five schools were selected by stratified random sampling, using lottery method (1 urban private +1 urban government +1 rural private +2 rural government). To achieve the required sample size, a minimum 400 students was planned to be selected from each of the schools; however, all the eligible students in the schools were included in the study. Number of students studying in the rural government school was less than 400, so another closest government school was also included in the sampling frame. All the students in the selected schools were included in the study for interview and examination. Children who are enrolled but discontinued from school are excluded from the study. Subsequent visits are made in the next 2 consecutive days to include the students who were absent to school on the day of data collection and for the students who forgot to get the consent forms signed from their parent/guardian. Distant vision was tested using Snellen's chart and color vision was tested using pseudoisochromatic plates (17) of Ishihara's chart. The Institute ethics committee clearance was obtained before starting the study. Permission was obtained from the education department before the study was started. Principals of the selected schools were approached and permission was obtained from the school principals/head masters for carrying out the study on selected dates given by the school management. Participant information sheet, consent form, and assent forms were distributed to the students 2 days before date of data collection and the students were asked to obtain consent from their parents. A child with presenting maximum vision ≤6/12 Snellen equivalent in the better eye is considered visually impaired. Students who watch television (TV) for at least 1 h a day for at least 5 days in a week or those who watch at least 5 h in a week are classified as "Watching TV." Games played in digital electronic gadgets such as TV, play station, computer/laptop, handheld gaming devices, and mobile phones are considered video games. Activities done at a closer distance from the eyes such as reading, writing, drawing, embroidery works, and fine arts are considered near work activities. Data were entered in Microsoft Excel 2013 and analyzed using the statistical software SPSS version 21.0 (IBM, New York, USA). Chi-square test was applied for testing difference in proportion and a $P < 0.05$ was considered statistically significant [Figure 1].

Results

The study population was evenly distributed among different age group, gender, and type of school in which the students were studying [Table 1].

The overall prevalence of visual impairment (vision ≤6/12) among the study participants was 6.37% (95% confidence interval [CI] =5.27–7.47). The prevalence of visual impairment increased with age and it was found to be high among male students (6.6%) when compared to female students (6%). However, both of the above observations were not statistically significant. The prevalence of visual impairment was found to be significantly high among the students who belonged to private schools (7.5%) and schools in urban regions (9.1%) when compared to government schools and rural region, respectively. Furthermore, students with positive family history of spectacle use were observed to have a significantly higher prevalence (8.8%) [Table 2].

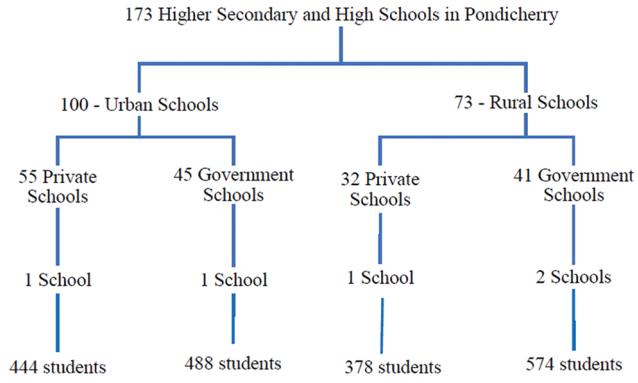

Figure 1: Schematic representation of sampling frame

Table 1: Distribution of study participants based on sociodemographic characteristics

	Frequency (%)
Age-wise distribution of study participants (years)	
10-11	358 (19.0)
11-12	369 (19.6)
12-13	392 (20.8)
13-14	387 (20.5)
14-15	378 (20.1)
Distribution of study participants based on gender	
Males	1024 (54.0)
Females	860 (46.0)
Distribution of study participants based on school location and type	
Urban	
Private	444 (23.5)
Government	488 (25.9)
Rural	
Private	378 (20.1)
Government	574 (30.5)
Total	1884 (100.0)

Table 2: Association between visual impairment and selected sociodemographic determinants (*n*=1884)

Determinants	Visual impairment			*P*	OR
	Present, *n* (%)	Absent, *n* (%)	Total, *n* (%)		
Age (in years)					
10-11	19 (5.3)	339 (94.7)	358 (100)	0.565	Ref
11-12	25 (6.8)	344 (93.2)	369 (100)		1.297
12-13	22 (5.6)	370 (94.4)	392 (100)		1.061
13-14	31 (8.0)	356 (92.0)	387 (100)		1.554
14-15	23 (6.1)	355 (93.9)	378 (100)		1.156
Gender					
Male	68 (6.6)	956 (93.4)	1024 (100)	0.599	0.9
Female	52 (6.0)	808 (94.0)	860 (100)		
Region					
Urban	85 (9.1)	847 (90.9)	932 (100)	0.0001	2.63
Rural	35 (3.7)	917 (96.3)	952 (100)		
Type of school					
Private	62 (7.5)	760 (92.5)	822 (100)	0.05	1.41
Government	58 (5.5)	1004 (94.5)	1062 (100)		
Family history of spectacle use					
Yes	45 (8.8)	468 (91.2)	513 (100)	0.009	1.66
No	75 (5.5)	1296 (94.5)	1371 (100)		
Duration of sleep (h)					
6-8	87 (7.4)	1085 (92.6)	1172 (100)	0.05	1.71
9-10	27 (4.5)	575 (95.5)	602 (100)		Ref
11-12	6 (5.5)	104 (94.5)	110 (100)		1.23
Servings of vitamin a rich food items consumed in a week					
>20	61 (6.2)	916 (93.8)	977 (100)	0.190	
11-20	49 (6.0)	766 (94.0)	815 (100)		
0-10	10 (10.9)	82 (89.1)	92 (100)		
Total	120 (6.37)	1764 (93.6)	1884 (100)		

OR: Odds ratio

Similarly, higher prevalence was also observed in students who are not playing outdoor games, watching TV, playing video games, using computers/laptops, and involved in near work activities for more than 3 h were observed to have a higher prevalence of visual impairment although the difference was not statistically significant. A higher number of children with visual impairment were below average in their (self-reported) academic performance [Table 3]. Children who play video games at a closer distance (<4 feet) from digital screens are found to have visual impairment ($P = 0.01$), also higher proportion of children were visually impaired who watch TV at a closer distance (<4 feet) although this association was not statistically significant [Table 4].

Presenting vision of 6/6 was observed in 79.8% of the children while with pinhole correction, the proportion increased to 94.6%. Presenting vision of the children who were already wearing spectacles at the time of examination showed that only 52.7% of them had a vision of 6/6 while the remaining children remain under corrected [Table 5].

Discussion

In our study, the prevalence of visual impairment was found to be 6.37% (95% CI = 5.27–7.47), visual impairment was significantly high among the students studying in urban schools (9.1%), when compared to the students in rural schools (3.7%). Family history of spectacle use was found to be significantly associated with visual impairment among the school students. Visual impairment was high among the children (8.7%) who were playing video games at a distance of 4 feet or less.

Krishnamurthy *et al.*[16] also reported a similar prevalence of 6.5% in a study conducted at Mysore. Murthy *et al.*[17] in a study done at Andhra Pradesh observed the prevalence of visual impairment of 6.7% in right eyes and 6.5% in left eyes which was similar to the results of the present study. A positive association between age and visual impairment due to myopia was observed in most of the studies. Kishore *et al.*[18] in a study among school children in Uttarakhand observed a higher prevalence in older age groups; however, in the present study, this association was not statistically significant. Bhatt[19] in a study among school students aged 7–15 years in Ahmedabad showed that the prevalence of myopia (vision <6/12) was significantly high among urban region (15.9%) when compared to rural region (4.1%). Krishnamurthy *et al.*[16] (2014) also found a significantly higher prevalence of uncorrected refractive error among urban school children when compared to students of rural schools. The results of the above studies were consistent with that of the present study. While regarding the type of school to which the children belonged to Prasanna Kamath *et al.*[20] in their study among 1300 rural school children in Karnataka in the age group of 6–15 years found that the prevalence of refractive error was high among private school children (6.5%) when compared to the student who belonged to government schools (4.7%), which were similar to the present study results. Mutti *et al.*[21] study presented that children with myopia spent more time in near work activities

Table 3: Association between visual impairment and selected determinants (*n*=1884)

Determinants	Visual impairment			*P*	OR
	Present, *n* (%)	Absent, *n* (%)	Total, *n* (%)		
Playing outdoor games					
Yes	94 (6.3)	1406 (93.7)	1500 (100)	0.718	0.92
No	26 (6.8)	358 (93.2)	384 (100)		
TV watching					
Yes	116 (6.4)	1698 (93.6)	1814 (100)	0.819	1.13
No	4 (5.7)	66 (94.3)	70 (100)		
Playing video games					
Yes	48 (7.4)	599 (92.6)	647 (100)	0.177	1.3
No	72 (5.8)	1165 (94.2)	1237 (100)		
Using computers/ laptops (excluding the time spent for playing games)					
Yes	45 (7.2)	580 (92.8)	625 (100)	0.298	1.23
No	75 (6.0)	1184 (94.0)	1259 (100)		
Duration of near work activities (h)					
≤3	71 (6.1)	1090 (93.9)	1161 (100)	0.567	0.9
>3	49 (6.8)	674 (93.2)	723 (100)		
Self-reported academic performance					
Good	55 (6.3)	814 (93.7)	869 (100)	0.591	Reference
Average	33 (6.2)	502 (93.8)	535 (100)		0.97
Below average	10 (8.7)	105 (91.3)	115 (100)		1.4
BMI					
Normal and below	100 (6.1)	1551 (93.9)	1651 (100)	0.141	Reference
Overweight	13 (7.4)	163 (92.6)	176 (100)		1.24
Obesity	7 (12.3)	50 (87.7)	57 (100)		2.17
Total	120 (6.37)	1764 (93.6)	1884 (100)		

OR: Odds ratio; BMI: Body mass index

Table 4: Association between digital screen usage distance and visual impairment

Determinants	Visual impairment			*P*	OR
	Present, *n* (%)	Absent, *n* (%)	Total, *n* (%)		
TV watching distance*					
4 feet or less	74 (7.3)	936 (92.7)	1010 (100)	0.184	1.32
4-8 feet	30 (5.1)	561 (94.9)	591 (100)		0.90
8 feet and above	12 (5.6)	201 (94.4)	213 (100)		Reference
Video games playing distance#					
4 feet or less	45 (8.7)	474 (91.3)	519 (100)	0.014	3.95
4 feet and above	3 (2.3)	125 (97.7)	128 (100)		

*n=1814; #n=647

Table 5: Distribution of study participants based on their presenting maximum distant vision

Visual acuity	Presenting vision, *n* (%)	Vision with pin hole, *n* (%)	Presenting vision of students previously wearing spectacles, *n* (%)
6/6	1504 (79.8)	1782 (94.6)	69 (52.7)
6/9	260 (13.8)	59 (3.1)	45 (34.4)
6/12	50 (2.7)	17 (0.9)	6 (4.6)
6/18	41 (2.2)	6 (0.3)	6 (4.6)
6/24	19 (1.0)	11 (0.6)	2 (1.5)
6/36	8 (0.4)	8 (0.4)	2 (1.5)
6/60	2 (0.1)	1 (0.1)	1 (0.7)
Total	1884 (100)	1884 (100)	131 (100)

and less time in sports compared with emmetropes. However, watching TV, playing video games, or working on computer did not differ between myopes and emmetropes. The above observations were comparable to the results of the present study. Kalikivayi *et al.*[22] reported that the prevalence of visual acuity of <6/60 was 0.5% and Murthy *et al.*[14] reported in their study as 0.47% while in the present study, it was found to be 0.1% [Table 4]. In a study by Khan *et al.*,[23] it was observed that 71.32% of the children had a vision of 6/6 which was in the lower side when compared to 79.8% as observed in the present study [Table 5], while Basu *et al.*[24] reported a similar prevalence of 84.78% in their study done in Surat.

Strengths of our study include that schools representing all the regions (urban/rural) and school types (private/government) were studied, various possible determinants were studied, and significant number of children with visual impairment was newly diagnosed and referred to an ophthalmologist for refraction. Our study limitations are a relatively small sample was studied because of which all the determinants could not be studied; however, the primary objective of the study was to measure the prevalence. Refraction was not done to the students because of nonfeasibility. Further large-scale analytical studies may be required to establish strong evidence regarding the etiology and determinants of visual impairment.

Conclusion

The prevalence of visual impairment in our study population was found to be 6.37% and the prevalence was even higher among children who belonged to schools of urban region or private schools. Children with a positive family history of spectacle use were more likely to have visual impairment. The prevalence of visual impairment increased as the age of the child advanced.

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Conflict of interest

There are no conflicts of interest.

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