Original Article

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Prevalence and awareness of color vision deficiency in school children

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Abstract

Context: There is paucity of data on the topic of color vision deficiency on a large scale. Studies on color vision deficiency in Hyderabad are not found. *Aims:* To study the prevalence and awareness of color blindness in school children of class V to X. *Settings and design:* School based cross sectional study conducted at schools located in Quthbullapur, Hyderabad. *Methods and material:* During the study period a total of 1000 school children belonging to classes V-X were screened for the presence of color vision defect. At the same time their knowledge was also assessed related to color vision defect. Ishihara Chart was used for screening of color vision defect. *Statistical analysis:* Proportions were used to analyze the data. For association study, chi square test was used. P value of less than 0.05 was taken as statistically significant *Results:* Males (1.33%) were more affected with color vision deficiency than the females (0.25%). 752 students had knowledge about color vision deficiency. 248 students could not define color blindness. Out of the 752 children having knowledge, most (87.6%) took precautions for color vision deficiency by various means...such as; getting eye check-ups regularly, or having seen the ishihara chart before. Knowledge was directly associated with precautions taken. A large proportion of 87.6% among those who had knowledge took precautions compared to only 9.3% who had no knowledge. This difference was statistically significant. *Conclusion:* The prevalence of color vision deficiency though low is significant. Knowledge levels are not adequate among the children.

Keywords: Prevalence, awareness, color blindness, spectrum, disorder

Introduction

When a person is not able to recognize some colors especially red and green or any other color then the person is said to be suffering from color vision deficiency. Males are more commonly affected as it is an X linked disorder. But some cases do occur in females also [1].

Color blindness is caused by either genetic or acquired factors. Genetically, "colour blindness is an inherited sex linked anomaly. The gene responsible is present on the arm of the X-chromosome and females are carriers. Females will suffer when both X-chromosomes carry the defective gene."[2]

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"Congenital color blindness occurs in two forms-total and partial. The former is very rare and is generally associated with nystagmus and a central scotoma." [3]

"Less commonly, color blindness is acquired as a result of eye disease like disorders of the optic nerve, inadequate vitamin A (beta-carotene) in the diet, inflammation of the eye, and cataract. Acquired color blindness is usually blue-yellow." [2]

Incidence of color blindness in males occurs in about 2-2.5% of the population; and in females the defect is present in only 0.4% of the population." [3]

"Inherited deficiencies cannot be cured. In some cases, tinted eyeglasses can be worn to increase contrast between colors. Color vision loss caused by eye disease may be improved with treatment of the disease." [2]

There is paucity of data on the prevalence of color vision deficiency in the general population. Studies on color vision deficiency in Hyderabad are not found. Hence present study attempts to focus on prevalence of color vision deficiency in school going children in Hyderabad and their knowledge

about color vision deficiency.

Materials and Methods

Study design: Present study was a school based cross sectional study using diagnostic test material.

Setting: It was conducted at schools located in Quthbullapur, Hyderabad.

Study period: From April 2014-August 2014

Sample Size:

A total of 1000 students were screened for the prevalence of color blindness. Sample size of 1000 was taken considering that minimum of this sample would be sufficient for the present study.

Inclusion criteria:

1. Students of both genders
2. Students of classes V – X

Exclusion criteria:

1. Students absent on the day of visit to school
2. Students not willing to participate in the study

Methodology:

The proposal was submitted to the Institutional Ethics Committee before the study was initiated. After their approval Quthbullapur Municipality was selected randomly from among all Municipalities of Greater Hyderabad Municipal Corporation. A list of schools was prepared having classes from class V to class X in the randomly selected Quthbullapur Municipality area. Out of all the schools, 10 schools were randomly selected and permission from the principal/Head Master of the schools was sought. All school heads gave the permission. From each school 100 children were screened i.e. about 16-17 from each class.

During the study period a total of 1000 school children belonging to classes V-X were screened for the presence of color vision defect. At the same time their knowledge was also assessed related to color vision defect.

Ishihara Chart was used to screen all selected children. The amount and type of color vision defect was noted accordingly. The charts were made of poly-chromatic plates and were printed with figures or designs in colored circles with a background of the similarly shaped colored circles. The plates were held in natural daylight at a distance of 40 cm. The individual getting tested had to answer without more than 3 seconds of delay. Thus color vision deficiency was assessed. Those found positive were later once again confirmed using same method as mentioned above.

Following questions were asked to assess knowledge

1. Do you know what color vision deficiency is?
2. What precautions do you take for eye care?

The children were counseled in regards to their career options and how to deal with the disorder. Lastly, awareness was raised and regular eye check-ups and color vision check-ups were encouraged.

Statistical analysis:

Proportions were used to analyze the data. For association study, chi square test was used. P value of less than 0.05 was taken as statistically significant.

Results

Table 1 shows prevalence of color blindness among school children. It was observed that there were a higher percentage of males who had color vision deficiency than the females. Out of the 600 male students surveyed, 8 (1.33%) of them had color vision deficiency. Out of the 400 females surveyed, only one (0.25%) had color vision deficiency.

Table 2 shows distribution of children as per knowledge of color blindness. It is seen from the table that out of the 1000 children surveyed between the grades of V-X, 752 students had knowledge about color vision deficiency. 248 students could not define color blindness. That being said, a total of 75.2% of students had the minimal knowledge whereas 24.8% did not have any knowledge.

Table 1: Prevalence of color blindness among school children

Color blindness	Male		Female		Total	
	Number	%	Number	%	Number	%
Yes	8	1.33	1	0.25	9	0.9
No	592	98.67	399	99.75	991	99.1
Total	600	60	400	40	1000	100

Table 2: Distribution of children as per knowledge of color blindness

Knowledge of color blindness	Number	%
Yes	752	75.2
No	248	24.8
Total	1000	100

Table 3: Distribution of children as per precautions taken to prevent color blindness

Precautions taken to prevent color blindness	Number	%
Yes	659	87.6
No	93	12.4
Total	752	100

Table 4: Association between knowledge and precautions taken

Knowledge of color blindness	Precautions taken		Total	Chi square	P value
	Yes	No			
Yes	659 (87.6%)	93 (12.4%)	752 (75.2%)	524.4	< 0.0001
No	23 (9.3%)	225 (90.7%)	248 (24.8%)		
Total	659 (65.9%)	341 (34.1%)	1000 (100%)		

Table 3 shows distribution of children as per precautions taken to prevent color blindness. From the above table, it is seen that out of the 752 children having knowledge, most (87.6%) took precautions for color vision deficiency by various means such as; getting eye check-ups regularly, or having seen the ishihara chart before. The remaining 12.4% of students did not take any precautions regarding color vision defects.

Table 4 shows association between knowledge and precautions taken. Knowledge was directly associated with precautions taken. A large proportion of 87.6% among those who had knowledge took precautions compared to only 9.3% who had no knowledge. This difference was statistically significant.

Discussion

The research which revolved around the prevalence of color blindness in school children was important and necessary to both identify visually disabled children as well as to raise awareness while providing proper counseling. A thousand students were sampled in a cross-sectional study (600 males and 400 females) between the classes of V-X. An ishihara chart with pseudoisochromatic color plates was used to identify any color vision defects. Six plates were used with 3 chances for each plate. Results showed a male preponderance (1.33%) with color vision deficiency followed by a lower percentage for females (0.25%). These results were in accordance with the theoretical hypothesis that females may be carriers due to two X chromosomes whereas males are largely affected due to a lack of carrier state. It was also noted that children who did not have any knowledge about this visual disability did not take precautions.

It is seen that out of all the students surveyed between the classes of V-X, the male children seemed to have a higher preponderance to color vision deficiency than the females. The same results were seen in other studies conducted regarding the prevalence of color blindness among a group of individuals [4]. The female percentage of having color vision deficiency was dismal, having little or no value. For instance, in a study conducted by Moghaddam, "color vision deficiency in girls and boys was 0.2 and 1.6% ($p = 0.02$), respectively." [4] These results are very similar to this study with the female percentage having a difference of .05 and the male percentage having a difference of 0.27. Since color blindness is an X-linked disorder due to the homologous nature of color vision pigment genes, the incidence is higher in males than females. Females may be either carriers or may be having color defects. Males cannot be carriers as they only have one Y and one X chromosome. Thus, in almost all studies conducted regarding this topic have the same male preponderance and support the theory with their evidence. It is also observed that students who were aware and had knowledge about color blindness had taken steps by either regular eye check-ups or by having seen and done the Ishihara tests before. On the other hand, students who had no knowledge about the topic did not take any steps.

Ramchandran N et al [5] wrote a review which discussed the necessity of importance of color vision screening among school children. They concluded that " the most commonly used screening test (using Ishihara pseudoisochromatic plates) performs well with respect to detecting red-green color vision deficiencies.

Shrestha RK et al [6] carried out a study on color vision defects among the school going children. They screened 2001 children using Ishihara chart. Overall prevalence of color vision deficiency was 2.1% which is more than our finding of 0.9%. The prevalence among males was 3.9% whereas

it was zero in females as reported by the authors. We found one female student with color vision defect. The authors concluded that the prevalence of color vision deficiency was significantly more in Nepal

Shah A et al [7] carried out a study in Manipur, among Muslim community. They found a very prevalence of color blindness i.e. 8.73% among males and 1.69% among females. They studied six different populations and found that highest rates were observed among Meitei population amounting to 14.93% in males and 2.5% in females while they observed lowest rates of color blindness of 3.75% in males and zero percent in females among Naga populations. The authors concluded that their prevalence was very high compared to all other studies. They attributed this to the high prevalence of consanguineous marriages among Muslims. This particular aspect of consanguineous marriage was not included in the present study.

Al-Aqtum MT et al [8] conducted a study on color blindness in Jordan among 1418 university students. They used Ishihara chart to screen the students for color blindness. They reported that overall 23 (1.6%) students were found to have color blindness with males affected more 19 (8.7%) than females 4 (0.3%). Among four females with color blindness one was having protanomalia, one was with protanopia and two were with deuteranomalia. Among 19 males found with color blindness four were having protanomalia, three with protanopia, eight were having deuteranomalia and four were having deuteranopia.

Conclusion

In total, color vision deficiency has a high incidence in the male population because of a lack of carrier state due to a single X chromosome. Next, female individuals had a lower rate of color vision deficiency. Children who were aware of the disability had taken precautions such as attending regular eye check-ups and having done the Ishihara chart unlike the students who were not aware. The students with a lack of knowledge had a dismal percentage regarding precaution taking. To conclude, this research has helped to raise awareness of color blindness and urged children who had not passed the tests to consider carrier options appropriate and suitable to their disability. They were encouraged to live and grow in acceptance with the disorder and properly counseled.

Key messages: All schools should have screening for color vision deficiency and identified children should be educated to understand the severity of the problem and accept it positively.

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