

Prevalence of Colour Blindness in School Children

Saumya Agarwal¹, Nishant Bansod²

¹ DPU, Padmashree Dr. D. Y. Patil Medical College, Pimpri, Pune 18, India

² DPU, Padmashree Dr. D. Y. Patil Medical College, Department of Physiology, Pimpri, Pune 18, India

Abstract: Colour vision is a function of three types of cone pigments present in retina. Any abnormality in the cone pigments may cause deficiency of colour vision which is called as colour blindness. So the study was carried out in 595 students (348 boys and 247 girls) from Dr. D. Y. Patil Public School, Pimpri, and Pune, to find prevalence of colour blindness. Students were assessed using Ishihara's Type Test for colour blindness by 38 plate edition. Study revealed total 12 students (2.02%) were colour blind which include 11 boys (3.16%) and 1 girl (0.40%). It is observed that out of 11 boys with color blindness, 10 boys (2.87%) showed deuteranomaly and 1 boy (0.29%) showed protanomaly whereas girl showed deuteranomaly. Prevalence rate for colour blindness is found to be higher in males (3.16%) than in females (0.40%). This is true for congenital colour blindness. In which red-green colour blindness is the common most defect which is inherited as X-Chromosome –linked recessive. As male have only one X-chromosome, they are prone to suffer from the defect while females are mainly carrier. This study is helpful to colour blind students to know their disability and to adjust appropriately to overcome their difficulties.

Keywords: Colour Blindness, Protanomaly, Deuteranomaly, Ishihara's Charts, X-Chromosome Recessive

1. Introduction

Colour vision is the ability to discriminate a light stimulus as a function of its wavelength. Light with wavelength between approximately 380 and 760 nm causes photoreaction on human retina, which leads to vision. Various sensory and cognitive processes combine to result in the sense of colour. [12]

The description and appreciation of colours depend upon the ability of receptors in retina i.e. rods and cones. Rods are mainly responsible for black and white vision whereas cone systems are mainly responsible for colour vision. The Young Helmholtz theory of colour vision in human, postulates the existence of three kinds of cones, each containing a different photo pigment and maximally sensitive to one of the three primary colours. Only one of the three type of colour pigments is present in each of the different cones. The colour pigments are called: blue-sensitive pigment, green-sensitive pigment and red-sensitive pigment showing peak absorbencies at light wavelength of 445, 535, and 570 nm, respectively [5] Red, green and blue are thus called primary colours as any colour can be produced by mixing appropriate proportion of red, green or blue colour.

Colour blindness is the commonly used term for deficiency of colour vision. David Brewster introduced the term colour blindness, which was formerly known as daltonism, after John Dalton, who described in detail his own inability to distinguish red [12]. Colour blindness is commonly present as inherited abnormality in Caucasian populations in about 8% of males and 0.4% of females. [4] The lowest rate, which is about 2% of males, occurs in the aboriginal populations of Australia, North America, South America and Fiji and in certain Asian Indian tribes [2]

In addition to hereditary condition, colour blindness may occur due to acquired conditions such as serious ocular diseases, injury or diseases of retina, toxicity or systemic conditions [2]. Many people are affected by colour blindness but many of them remain undetected as they simply adapt to the environment to certain extent and also because of

unawareness of the disease. Unaware about the disability, student may have difficulties in certain aspects while learning in school and student may not be able to reach his /her actual potential. Also colour blind person, unaware of his disability, may choose certain professions, which may not be suitable for him, like traffic policeman, train driver or technician in colour industries, which require proper perception of colours which may lead to lesser efficiency in work as well as may cause accident. So it is important to look at the prevalence of colour blindness in children and identify the problems associated with it. The sooner the colour deficiency can be identified the sooner accommodation can be made to help the child. Considering these aspects, the study is carried out so as to find out prevalence of colour blindness in school children so that they can be guided properly in their learning process as well as in choosing and adjusting with the suitable profession.

2. Aims and Objectives

- 1) To find out the prevalence rate of colour blindness in students of Standard V to Standard X, in Pad. Dr D.Y.Patil Public School, Pimpri, Pune.
- 2) To find out the prevalence rate of colour blindness in male and female students separately of Standard V to Standard X, in Pad. Dr D.Y.Patil Public School, Pimpri, Pune.
- 3) To compare the prevalence rate within male and female students.
- 4) To find out the type of colour blindness in affected individuals and prevalence of that type.

3. Literature Survey

In a study, total 1553 male and 519 female school children of Patiala between the age group of 10 & 15 years were tested for colour blindness by Ishihara Charts, Edridge-Green Lantern and Pickford Nicolson Anomaloscope. They found 3.85% male and 0.38% female to be colour blind [7]

Survey carried out in a rural community of Pune district to find out colour blindness using Pseudoisochromatic Plates of Ishihara in all individuals above 8 years observed low prevalence of colour blindness in the area as compared to generally accepted prevalence of 8% in males and 0.69 % in females. It is attributed to the racial variation or to the differences in detection methods [10]. In a population based study, 2058 secondary school students(1136 males & 922 females) in Tehran, were examined with Ishihara Pseudoisochromatic Colour Plates and total 97 cases of defective colour vision (93 males & 4 females) were detected. Of the 93 cases (8.18%) of defective colour vision in male, 56 cases (4.93%) involved deuteranomaly, 13 cases (1.14%) protanomaly, 13 cases (1.14%) deuteranopia & 11 cases (0.97%) protanopia. Whereas 4 cases (0.43%) of defective colour vision in female, 3 cases (0.32%) involved deuteranomaly and 1 case (0.11%) involved protanomaly. [8]

Study on 1418 university students (1200 females and 218 males) from Zarka Private University and The Hashemite University by using Ishihara Pseudo-isochromatic colour plates found a total of 23 individuals to be colour blind. It is found that 19 (i.e.8.72%) male students were colour blind which include 4 protanomalialia, 3 protanopia, 8 deuteranomalialia & 4 deuteranopia whereas only 4(i.e. 0.33%) female students were colour blind which include 1 protanomalialia, 1 protanopia and 2 deuteranomalialia [9]. Study conducted on 1427 health personnel and medical students ,using 24 plate Ishihara's Test of colour vision, found Red-Green colour vision deficiency in total 45 persons(3.2%) which includes 42 males(6.7%) and 3 females (0.4%). [1]

School cohort study screened 1249 children, aged 13-15 years, using Ishihara plate for Red- Green colour blindness observed 33 children to be colour blind which include 32 boys (5.3 %) and 1 girl (0.2%). It also observed, overall 5.4% of Chinese, 4.9% Of Malay and 4.9% Of Indian boys to be colour blind. [3]

4. Problem Definition

Colour blindness is not physically debilitating, but it can have a major impact on one's day to day life. Person suffering from it may not be able to differentiate between red and green traffic signals, may face difficulties in job as seen for technician working in colour industries. Also colour testing is an integral part of the physical requirement for certain occupation. Children may have negative impact on school and learning and so on. And above all many students may remain undetected if proper examination is not carried out and thus appropriate arrangement is not done by himself or by teachers or parents to overcome the difficulties

5. Material & Methods

5.1 Material

Ishihara's type tests for Colour-Blindness, 38 Plates Edition.1991. Eye Care, Ludhiana, India. Subjects included in the study consist of total 595 students (348 boys and 247 girls) from Std V to X, in age group between 9 & 16 years, studying in Pad. Dr D.Y.Patil Public School, Pimpri, Pune. Approval from Institutional Ethical Committee and

permission from Principal, Pad. Dr D.Y.Patil Public School was taken to conduct the study. Informed consent was taken from all the students.

5.2 Methods

Student was called according to the roll number in a room. Clinical examinations of both eyes were done. Age and sex of the student were noted. The student was tested for colour vision deficiency using Ishihara's Type Tests for Colour-Blindness, 38 Plates Edition.

The colour vision testing plates were held at 75 cm from the student and tilted at right angle to the line of vision. The test was done in adequate lighted room resembling natural day light. Student was asked to read the numbers seen on the test plates and answer was noted down. The time given for telling the number on a plate was less than 5 sec [1]. Assessment of the reading of the plate determines the normality or defectiveness of colour vision and also the type of colour blindness. It was interpreted as per the instructions given on the booklet provided with Ishihara's type tests for colour blindness so as to identify subject suffering from colour blindness and also to differentiate the type of colour blindness. All the students were examined within two months duration.

6. Observations & Results

6.1 Statistical Analysis

Prevalence of colour blindness in school children was calculated by using following formula. Prevalence=Number of all current cases of a specific disease existing at a given point in time \times 100/Estimated population at the same point in time [11]. Also prevalence of colour blindness was calculated for boys and girls, separately.

6.2 Results

Table 1: Showing students examined and colour blind students

Class	Students Examined			Colour Blind		
	Total	Male	Female	Total	Male	Female
V	93	57	36	1	1	0
VI	135	81	54	2	2	0
VII	150	91	59	4	4	0
VIII	75	37	38	3	2	1
IX	77	42	35	1	1	0
X	65	40	25	1	1	0

Table 2

	Total	Male	Female
Number of Students Examined	595	348	247
Number of Colour blind Students	12	11	1
Prevalence of Colour blindness	2.02%	3.16%	0.40%

7. Discussion

Considering this, the study was conducted to determine prevalence rate of colour blindness in total 595 students (348 boys and 247 girls) , in the age group between 9-16 years ,from Pad. Dr D.Y. Patil Public school, Pimpri, Pune,

by using Ishihara's Type tests for colour blindness, 38 plate edition.

On assessment, total 12 students (i.e. 2.01%) were found to be colour blind which include 11 boys (i.e. 3.16%) and 1 girl (i.e. 0.40%). These 11 boys with colour blindness include , 10 boys with deuteranomaly (i. e. 2.87%) and 1 boy with protanomaly (i. e. 0.29%). Also the only girl with colour blindness was found to be suffered from deuteranomaly. From the study, it is observed that the prevalence of colour blindness in girls is 0.40% which is similar to the prevalence of colour blindness observed in other studies. i.e. 0.50% [2] , 0.40% [6]. And 0.38%[7]

It is also observed that the prevalence of colour blindness in boys is 3.16% by this study which is slightly less than 8% prevalence rate observed in male among Caucasians in Europe, Great Britain and United States [2] but it is similar to 3-4% prevalence rate of colour blindness in the Indian population [6], 3.85% prevalence rate in male school children of Patiala. [7] whereas it is slightly more than the lowest prevalent rate i. e 2% observed in North America, South America, Fiji and in certain Asian Indian tribes 2]

Thus though the prevalence rate for colour blindness is quite similar all over the world but a smaller difference in the prevalence rate is observed which may be attributed to the racial variations in the different population.

From this study it is also observed that prevalence rate of colour blindness is much higher in males (i.e. 3.16%) as compared to that in females (i.e. 0.40%).

This can be explained depending on the pattern of inheritance of colour blindness.

8. Conclusions

In many cases, colour blind students may remain undetected and student remains unaware about the disability. It may cause difficulties in various aspects of learning which then resulted into decrease in interest and lesser efficiency in work, preventing the student to reach up to his/her maximal potential. Early detection of colour vision abnormality and its associated problems in children, allow parents and teachers to make appropriate adjustment in teaching methods or to take other available measure for the benefit of student.

Thus certain profession may not be suitable to such person which may lead to decreased efficiency of the work and sometime even may lead to accident. Knowledge about the prevalence rate of colour blindness and its early detection may prove to be helpful in choosing or avoiding certain professions or jobs as well as making appropriate adjustment in certain jobs. Considering the various aspects, this study is a step to know more about colour blindness so as to help the colour blind person to know the disability and to get adjusted in better manner to overcome the difficulty.

9. Future Scope

Early detection of colour vision abnormality and its associated problems in children, allow parents and teachers to make appropriate adjustment in teaching methods or to

take other available measure for the benefit of student. Also colour blind person may found it difficult to work in certain professions which require proper colour perception like traffic policeman, railway driver, technicians in colour industries.

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Author Profile



Saumya Agarwal graduated M.B.B.S from Pad Dr. D.Y.PATIL Medical College Pimpri, Pune in 2011 .Also served as a medical officer in charge at PHC Dhar, badgaon, distt Udaipur, Rajasthan. Presently working as a junior resident in Orthopaedics at Jawahar lal Nehru Medical College, Belgaum, Karnataka, India

Nishant Bansod, Department of Physiology, Pad Dr. D.Y.PATIL Medical College Pimpri, Pune, India