PREVALENCE OF CONGENITAL COLOUR BLINDNESS IN A TERTIARY EYE CARE CENTRE

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ABSTRACT

BACKGROUND

Colour blindness is usually caused by X linked recessive inheritance in which total colour blindness is rare while common is partial colour blindness. Among the partial colour blindness patients red-green colour blindness is more common followed by blue-yellow colour blindness. Partial colour blindness occurs in 8% of male population and 0.5% of female population with red-green blindness.

The aim of the study is to identify the colour blindness among medical, paramedical staff including nursing students, job seeking persons from police, pilot, and candidates of various technical, engineering and routine master health check-up; about 3500 cases were screened at ophthalmology department, Government Kilpauk Medical College, Chennai during the period September 2017 to December 2018.

MATERIALS AND METHODS

Police personnel coming for routine eye check-up, candidates coming for master health check-up, job seekers coming for evaluation of eye fitness, medical and paramedical staff including nursing students were examined from September 2017 to December 2018 and the total number of cases was 3500.

Routine ophthalmological examinations were carried out in all cases including slit lamp examination, visual acuity by Snellen's chart, Colour vision by Ishihara colour vision chart, intra ocular pressure by applanation tonometer, direct and indirect ophthalmoscopic examination and fundus photography.

RESULTS

In our study, we detected five male patients and one female patient suffering from defective colour vision. In male gender, out of 5 persons, 4 were suffering from partial colour blindness and 1 from total colour blindness with normal visual acuity, whereas only one female was detected to be suffering from partial colour blindness. All the partial colour blindness cases were having defect in appreciation of red and green colours, and they are inherited. Percentage of colour blindness in our case study is 0.17%.

CONCLUSION

As per our study, the colour vision deficiency cases were only partial in nature, particularly to red and green without any symptomatology. All were found to be suffering from colour blindness incidentally detected only during routine eye check-up, with Ishihara colour vision chart. Since, in India the defective colour vision is a remark for certain jobs like army, driving, pilot, engineering technical persons and police job, all the individuals must be checked for normal colour vision during school age itself.

KEYWORDS

Colour Vision Deficiency, Red-Green Colour Blindness, Ishihara Colour Vision Chart, Partial Colour Blindness, Total Colour Blindness.

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BACKGROUND

Colour blindness is a misnomer because this condition is neither blind nor are they not able to distinguish any colours. This condition is more appropriately called colour vision deficiency (CVD).

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Total colour blindness, called achromatopsia is a rare autosomal recessive (1/30,000) disorder characterised by reduced visual acuity and complete loss of colour discrimination due to loss of function of all three types of cone photoreceptors.

It is a genetic condition affecting 8-12% males and 0.5-1% females. The gene for L and M cone pigments are on the X chromosome, and this form of colour blindness is more common in males constituting 8% of population. Lack of S cone pigment in people (tritanopes) is very rare and it is not X linked.

Blue colour blindness occurs equally in both male and female. Because it is carried on a non-sex chromosome. 1% of male and female have tritanopia. Tritanopia is normal red and green vision but inability to distinguish between blue

and yellow by the person. Rod monochromacy is the most common type of complete colour blindness and its occurrence is 1 in 30,000 to 1 in 50,000. Even black can be confused as dark green or dark blue.

Protanomaly is reduced sensitivity to red light and deuteranomaly is a reduced sensitivity to green light. This is the most common type of colour blindness. These red-green colour-blind people have difficulty to distinguish red, green, orange and brown and they confuse with purple and blue. Inherited colour blindness in anomalous dichromacy, the ability to see colour will remain same always. But in case of acquired condition, their condition will get improved or become worse over time.

In case of people with dichromatic colour vision have two types of cones and total absence of one cone type resulting in non-perception of specific spectrum of light. The red-green cones perceive will overlap and that is the reason the red-green colour blindness see the world in a similar manner. In case of people with monochromatic vision see the world in old black and white television set and it is very rare condition occurring 1 in 30,000. The prevalence of tritanopes, tritanomaly and achromats is 1 in 30-50, 000 people. The acquired colour blindness in old age beyond 65 years common in 3% of world population especially seen in UK.

Out of 8% of male prevalence with partial colour vision defect which can be classified into 1% deuteranopes, 1% protanopes, 1% protanomaly and 5% deuteranomaly.

Two genes that produce red and green light sensitive proteins are located on the X chromosome. Mutation in these genes can cause colour blindness. It is a common inherited sex linked disorder that affects a person's ability to see or recognize certain colours. Most colour vision problems are inherited and are present since birth. People usually have three types of cone cells in the eye. Each type of senses either red, green or blue light. Individual can see colour when their cone cells sense different amounts of these three basic colours.

Red and green colour blindness is passed from mother to son on 23rd chromosome (sex). Red and green colour vision defects are more common than blue-yellow defects as well as complete absence of colour vision.

Anomalous trichromacy can be inherited but most often it is inherited. Monochromacy is a rare condition inherited and the patient sees the world with full grey. Tritanopia is blue-yellow defect and protanopia and deuteranopia is red-green colour blindness. The above-mentioned conditions come under dichromacy. Inherited colour blindness is most likely to affect the men, because it is sex linked trait.

David Brewster introduced the term colour blindness, formerly known as daltonism.[1] Most of colour blinds are undetected in general population due to absence of proper screening.[2]

As per study by Rogosic et al[3] reported a congenital dyschromatopsia prevalence of 8.448% in 15 to 45 age group study.

Grassivaro et al[4] reported 4.9% of colour blindness in his study. In a population-based study of prevalence of congenital colour deficiencies in secondary school students in Tehran, carried our by Modarres M, Mirsamadi M, Peyman GA.[5]

Ishihara Type Tests for colour blindness, 38 plates Edition is the most widely used screening test for red green colour deficiency.

Citirik et al[6] in their study from Turkey reported a red-green colour blindness.

Osuobeni[7] study in Arabian children the prevalence of red-green blindness as 2.9%.

Mohamed Fareed et al[8] reported in Jammu Province study that CVD prevalence in male ranged from 5.26%-11.36% and among female 1.15%-3.03%.

The average prevalence of CVD was 7.52% observed in males and 0.83% in female children. Male children tend to have higher CVD frequency which reinforce the fact of x-linked recessive nature of the trait. The single X-chromosome in male is predominant to colour blindness, while female with two X-chromosome can act as dosage compensation and decrease the risk of the disease. The frequency of red-green colour blindness among the male of Libya (2.2%), Saudi Arabia (2.9%), Nepal(3.9%), Singapore(5.3%), Thailand(5.6%), Eastern India(8.73%), were found higher than that among females.[9]

Hardy-Rand-Rittler (H-R-R) and Ishihara colour plates are used to assess the degree and type of colour deficiency. Tinted contact lens in one eye can increase the ability to differentiate between colours. Inherited colour vision deficiency management can be by injecting genetic materials into the eye using gene technology. The animal models of achromatopsia in dogs and mice have shown good results in restoring some cone function in the retina.

Weakness and absence of discrimination to certain colours tested by hue and saturation, thresholds of which can be plotted as polar coordinates on a circular diagram threshold with the chromatograph reveals more clearly than other clinical systems the true nature of colour defects as well as inconsistence in test methods. Ishihara colour test is a test to determine if the person has colour blindness. It was named after Dr. Shinobu Ishihara who first published the test in 1917 as Professor at the University in Tokyo. It is the most widely used screening test for red-green colour deficiency.

The patients were also tested for colour vision deficiency using Ishihara type test for colour blindness, 38 plates edition. The colour vision testing plates was held at 75 cm distance and tilted at right angles to the line of vision. The test was done in adequate lighted room. Patients were 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 five seconds. Assessment of the reading of the plate determines the normality or defectiveness of colour vision and also the types of colour blindness. Pseudoisochromatic plate tests are often used to test colour vision. Errors in reading the chart even in normal individuals can be present, hence giving proper instructions is important.[10]

The treatment for colour vision deficiency is concerned, Don McPherson invented EnChroma glasses which use a filter to cut out overlapping wavelengths, allowing for a clear distinction between colours especially red and green. This is useful in partial colour vision deficiency cases.

Improvement of red-green colour blindness by gene therapy was explored in the dichromatic adult squirrel monkey missing the L opsin gene. Sub retinal injection of a recombinant adeno associated virus expressing the L opsin resulted in trichromatic colour vision behaviour.

Objectives of the Study

1. To identify subjects suffering from colour blindness
2. To determine the type of colour blindness
3. To determine the prevalence of colour blindness and
4. To undertake gender wise distribution analysis.

MATERIALS AND METHODS

The study was carried out among 3500 cases whose colour vision was tested using Ishihara colour vision chart.

The cases were selected from medical, paramedical students including nursing students as well as newly job seeking persons and individuals for periodical medical health check-up including eye fitness reported in ophthalmology outpatient department, Government Kilpauk Medical College, Chennai. The case study duration was from September 2017 to December 2018, and it was a retrospective cross-sectional study.

Routine ophthalmological examinations were carried out in all cases including slit lamp examination, visual acuity by Snellen chart, Colour vision by Ishihara colour vision chart, intra ocular pressure by applanation tonometer, direct and indirect ophthalmoscopic examination and fundus photograph.

Inclusion Criteria

Medical paramedical and nursing students, job seeking persons such as marine engineers, pilot, police, various technical engineering persons and master health check-up individuals both male and female gender. The age group of individuals in our study was between 17 to 58 years

Exclusion Criteria

Macular lesions, Alzheimer's disease, leukaemia, sickle cell anaemia, drugs like chloroquine induced conditions, injury to eye, and ARMD were excluded from our study.

RESULTS

Out of 3500 cases screened in our study, male: female = 2783: 717 (79.51%:20.49%). The number of partial defective colour vision cases in our study was five and total colour blindness in one case. Among the five partial colour blindness is one was female and four were male persons. The total colour blindness is was seen in one male person. All five male persons with inherited character were having partial colour blindness.

All medical and paramedical students including nursing students who were examined in ophthalmology OPD as a part of physical fitness were found to be having normal colour vision. This imply that the incidence of colour blindness has come down as per our study. The inherited partial defective colour vision especially for red-green colour itself has come down.

Our study did not have any correlation of defective colour vision individuals with amblyopia or reduced visual acuity. All six individuals did not complaint about any symptomatology regarding defect in colour appreciation. This absence of symptoms in individuals mostly detected only incidentally by checking the colour vision by Ishihara colour vision chart. Other associated congenital ocular abnormalities were also absent in all the colour vision defective individuals.

In our study two types of colour blindness was seen, Protanomaly and deuteranomaly.

Number of police persons for job and master health check-up.	2720 (77.71%)
Number of medical students and para medical including nursing students.	780 (22.29%)
Total persons examined	3500

Table 1. Distribution of Examined Patients

Normal CV	3494
Partial colour vision defect present	Male 4 Female 1
Total defective colour vision	Male 1 Female -
Total persons examined	3500

Table 2. Prevalence of Normal Colour Vision and CVD with Respect to Gender

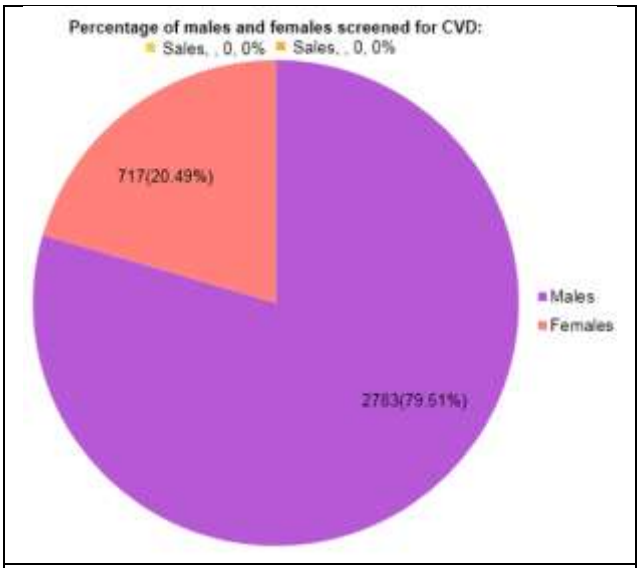

Image 1

Paramedical and medical students including nursing students	Male 283 Female 497
Normal CV	780
CVD cases	Nil
Total	780

Table 3. Prevalence of Normal Colour Vision and CVD Among Students

Police, master health check-up and job seeking persons screened	Male 2500 Female 220
CVD cases	6 (0.22%)
Normal cases	2714
Total	2720

Table 4. Prevalence of Normal Colour Vision and CVD among Police, Job Seeking and Master Health Check-Up Persons

Total cases screened	3500
Male	2783(79.51%)
Female	717(20.49%).
Normal cases	3494(99.83%).
CVD cases	0.17%

Table 5. Percentage of Each Subtype Among the Study Population

Total police, job seeking persons and master health check-up persons examined from September 2017 to December 2018 were 3500 in numbers. Out of these, we found six male persons were suffering from colour blindness. Among these six persons 5 were suffering from red-green colour deficiency and one person is suffering from total colour blindness. Percentage of colour blindness is 0.17%

DISCUSSION

Incidence of colour blindness in India is 5-8% in male and 0.5% in female population.[11] In our study we reported the increased prevalence of defective colour vision in male gender compared to female. Out of 2720 persons screened in police eye fitness check-up, job seeking persons for police, pilot, marine engineering and various technical department, to routine master health check-up for driver and police persons, we detected defective colour vision cases in 6 persons only out of which 5 were male and 1 female.

In our study cases all the medical, paramedical and nursing students of strength around 780 screened were reported to be having normal colour vision. Out of total of 3500 cases, CVD was reported in 6 cases with percentage of 0.17%. The persons screened in the age group of 17 to 20 years were having normal colour vision.

Beyond the second to sixth decade 6 persons suffering from colour vision deficiency was detected. Out of 6 cases 5 were suffering from partial colour blindness, whereas only 1 was suffering from total colour blindness. The partial colour vision deficiency to red and green colours was found in our study. Since we have not included the acquired colour blindness conditions like macular lesions, injury to eye, ARMD, vascular diseases complicating maculopathy and drug induced maculopathy, the normal colour vision individuals were 99.83%, this reflects that the ageing process did not cause deterioration from normal colour vision even up to 58 years of age in the study group. The already normal colour vision with eye fitness among the already existing job persons, who have come for routine master health check-up were also maintaining normal colour vision status right from the beginning of their service.

In our study predominantly congenital, inherited CVD cases either partial or total were detected. The reported CVD cases were having normal colour vision without amblyopia.[12] Our study shows less prevalence of defective colour vision, reflects that our study must have been extended to preschool and school children population which may reflect the increased prevalence of CVD.[13] Hence in routine eye check-up including colour vision must be done from preschool, school level, college level and job seeking category, so that exact prevalence of CVD in population can be found. So, treatment of CVD can be identified, and proper earlier treatment can be started.

Persons suffering from CVD adopt themselves by remembering the order of things in traffic light colours identification. Similarly, while doing the job also they get help from co-workers or from family members by organizing, labelling the clothing, coloured objects and furniture for ease of recognition.

Though the EnChroma glasses useful for partial colour vision deficiency especially red-green colour blindness, the success of gene therapy in human for colour vision deficiency management is not far away.[14]

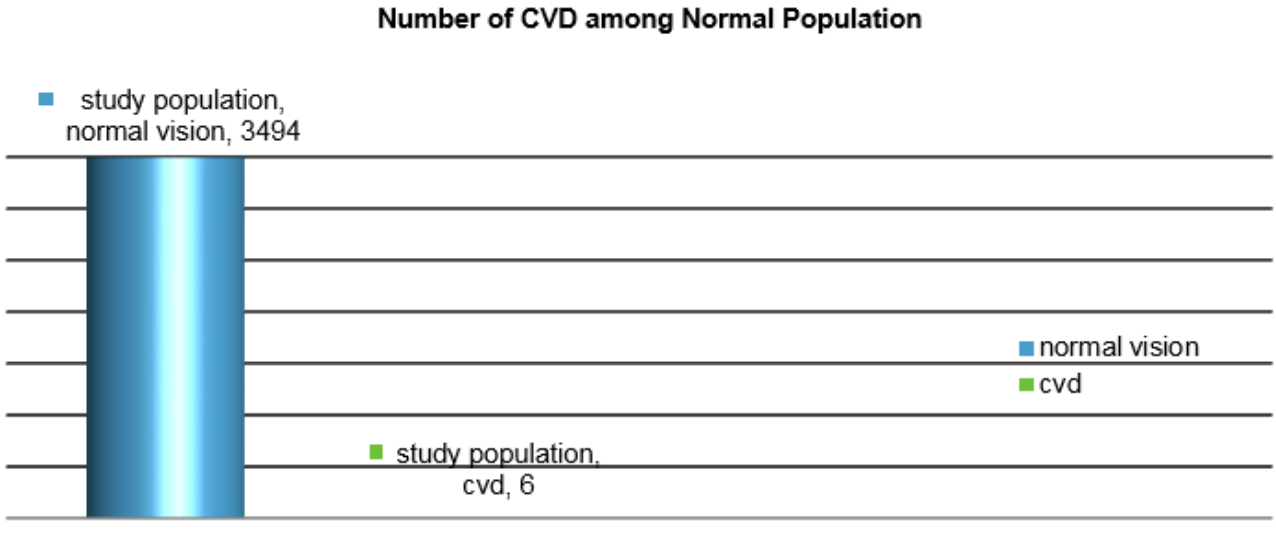

Image 2

CONCLUSION

Most of the time, a person with colour blindness was not aware of it and would come to know about it only during interview and ophthalmic check-up. Throughout the life time, the severity of inherited colour vision deficiency remains constant. It will not lead to blindness or additional vision loss.

Routine school age group colour vision check-up is mandatory apart from visual acuity assessment to find out the inherited partial or total colour blindness in the early stage itself in an individual so that the treatable conditions like acquired partial colour blindness cases can be identified and managed.

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