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Prevalence of Color Blindness in Females

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Abstract: The purpose of the paper is to find out the prevalence rate of color blindness in students of ages 18 years to 24 years. We have carried out the study on women population. A prospective study was done on 600 students to identify the prevalence of color blindness. Students were examined with Ishihara Color Plates test 38 edition. The data collected was compiled and analyzed to evaluate the prevalence of color blindness. Hardy Weinberg Equilibrium law was applied for calculations.
Keywords: Color blind, prevalence, Ishihara, Hardy Weinberg Equilibrium, Population

I. 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. Color vision is the ability to discriminate a light stimulus as a function of its wavelength. The description and appreciation of colors 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 color vision. Colors can be measured and quantified in various ways; indeed, a person's perception of colors is a subjective process whereby the brain responds to the stimuli that are produced when incoming light reacts with the several types of cone cells in the eye. In essence, different people see the same illuminated object or light source in different ways. 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 color. Color blindness is caused by either genetic or acquired factors. Genetically, color 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. 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. Inherited deficiencies cannot be cured. Color vision loss caused by eye disease may be improved with treatment of the disease. However, most of color blinds remain undetected in general population due to absence of proper screening. The Ishihara color test is a test to determine if a patient has color blindness.

II. MATERIALS AND METHODS

The study was carried out in St. Ann's College for Women, Hyderabad. Subjects included in this prospective study consist of 600 students of ages 18 years to 24 years. The students were tested for color vision deficiency using Ishihara's Type Tests for Color Blindness, 38 Plates Edition. The students were asked to sit approximately 75 cm away from the color vision testing plate, with each circle set at eye level. Preferable have mild natural lights. Being a printed plate, the accuracy of the test depends on using the proper lighting to illuminate the page. A 'daylight' bulb illuminator is required to give the most accurate results. Students 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 4 sec and not allow touching or tracing of the number. The Ishihara color vision test consists of a booklet, each page containing a circular pattern (or plate) comprising many dots of various colors, brightness & sizes. The seemingly random colored dots are arranged in such a fashion that a person with normal color vision will see a single-digit or two-digit number within the array of dots. But a colorblind person will either be unable to see a number or will see different number than the one seen by a person with normal color vision. Assessment of the reading of the plate determines the normality or defectiveness of color vision and also the type of color blindness. It was interpreted as per the instructions given on the booklet provided with Ishihara's type tests for color blindness so as to identify subject suffering from color blindness. The data collected was compiled and analyzed to evaluate the prevalence of color blindness.

A. Calculations

Total number of females = 600
Number of Color Blindness = 5
Incidence of color blindness (q2) = 5/600
= 0.00833

(These are the effected females)
According to Hardy Weinberg Equilibrium-
q = sqrt 0.00833 (q2)
= 0.09126
(These are the effected males because they have only one X chromosome)
p+q = 1
p= 1-q = 1-0.09126 = 0.90874
(These are the normal males)
Expected probability of heterozygotes out of total population = 2pq
= 2*0.90874*0.09126 = 0.16586
Expected probability of heterozygotes out of normal population = 2pq/p2 + 2pq = 2q/ 1+q
= 2*0.09126/1+0.09126 =0.16725
i.e. approx.17% of the females are expected to be carriers in the studied population.

III.RESULTS

Female students were screened in college for studying color vision of age group 18 to 24 years. Screening was carried out using Ishihara chart for color vision. Total of 600 female students were screened. Out of which 5 were found to be color blind. The gene frequencies were calculated. The proportion of affected females are 0.00833, which is approx. 0.8% and the proportion of affected males are 0.09126 which is approx. 9%, which is quite higher than females. The proportion of normal males are 0.90874 which is approx. 90%. The expected probability of heterozygotes out of the total population is 0.16586 and the expected probability of heterozygotes out of normal population is 0.16725whcih is slightly higher as expected .The 5 affected females out of 600 students were color blind accounting to prevalence of 0.00833% color blindness among students. By the calculations males were expected to be predominantly affected by color blindness as compared to females.

IV.DISCUSSION

Color blindness affects many people and most of the time they are unaware of this trait. Color blind children have certain learning difficulties. Only when they appear for some interview that they undergo ophthalmic checkup and come to know that they are suffering from this trait. Certain sectors like Defence and Railways need people who have normal color perception for proper signaling and hence color blinds get rejected. At that point the person goes through an emotional turmoil. Even day to day life gets affected due to different color perceptions like comprehending the traffic signals. Prevalence of color blindness is found to be higher in males than in females. This is true for congenital color blindness in which red green color blindness is the common most defect which is inherited as X-linked recessive. As males have only one X chromosome, they are prone to suffer from the defect in homozygous state while females are mainly carriers.

V. CONCLUSION

After successful completion of the study, students who were aware of the disability had taken precautions such as attending regular eye check-ups and having examined with Ishihara chart, unlike the students who were not aware. To conclude, this research has helped to raise awareness of color blindness and urged students who had not passed the tests to consider career options appropriate and suitable to their disability.

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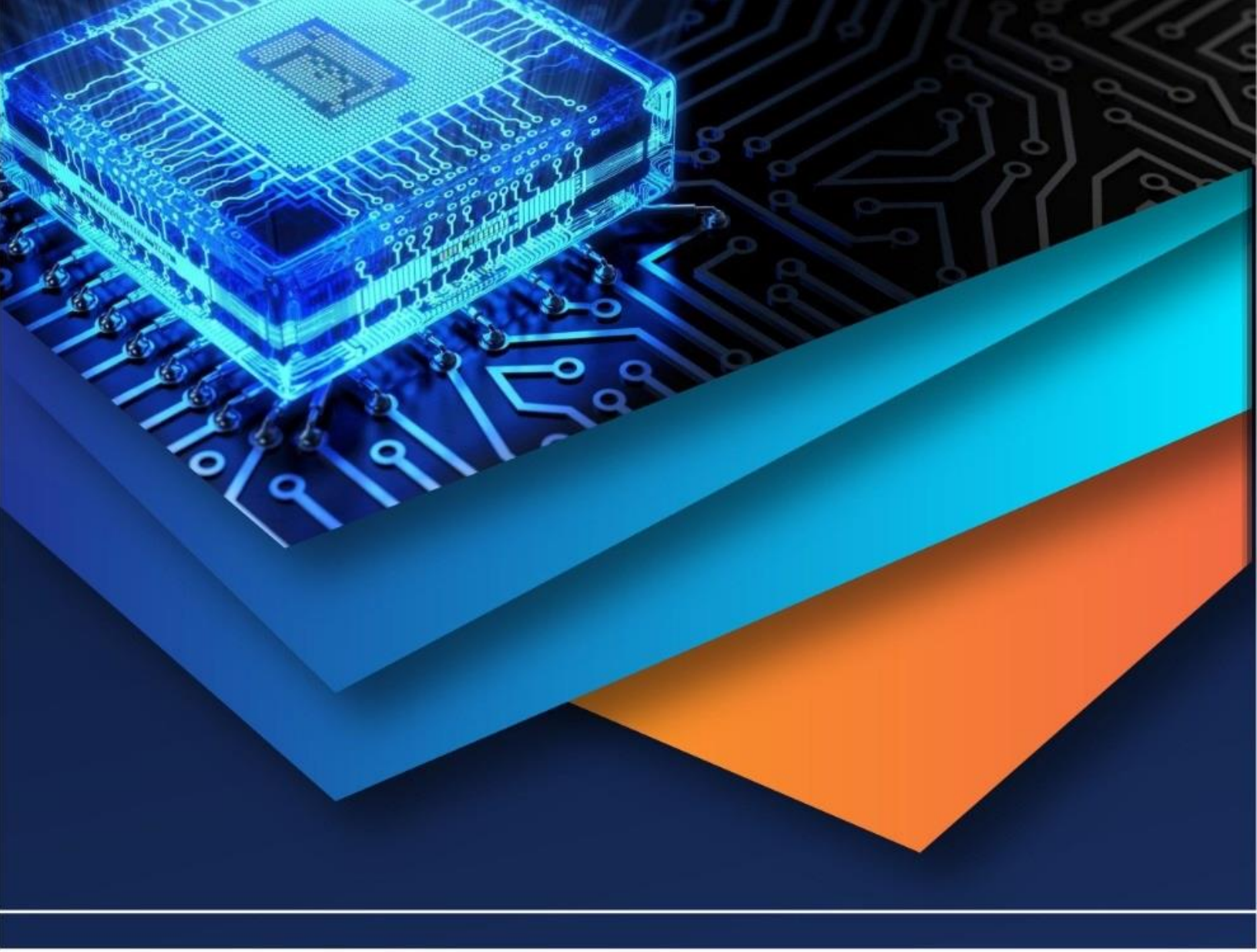

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