International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2024: 7.101

Assessment of the Prevalence of Colour Vision Deficiency among School Children in Bhadravati, Shivamogga District, Karnataka, India

H.S Suhas[1], E Chandrakala[2]

[1]Research Scholar, Department of Zoology, Karnatak University, Dharwad- 580 003
Email: *hssuhas192000[at]gmail.com*

[2]Lecturer, Department of Applied Zoology, Kuvempu University, Shankaragatta, Shivamogga
Corresponding Author Email: *genechandu[at]gmail.com*

Abstract: ***Colour blindness is an X chromosome linked recessive disorder inherited from mother to son. A cross-sectional study was conducted among the 1063 selected school children samples. The analysis found that 23 (2.16%) samples were identified with colour vision deficiency, all of which were males, with no females identified. Further, among the 23 identified colour blind students' samples, the protan type of CVD is observed in 3 students and is denoted as protanopes (red light). Similarly, the Deutan type was observed in 20 male students' samples. Among the CVDs, 23 male samples of Deutan (86.95%) were more prevalent than Protan (13.04%). The objective of this study is to assess the prevalence of colour vision deficiency and the screening of red-green colour blindness.***

Keywords: Colour vision deficiency, Mutation, Chromosome, Deutan, Protan

1. Introduction

Colour blindness, or colour vision deficiency (CVD), is the inability or decreased ability to perceive colour differences under normal light conditions (Wale et al., 2018). In 1798, John Dalton discovered colour blindness (Reddy et al., 2017). Rods are primarily responsible for black-and-white vision, while cone cells are mainly responsible for colour vision (Agarwal et al., 2014). However, when there is an error in the development of one or more types of retinal cone cells that receive colour in light and transmit the information to the optic nerve, CVD occurs (Chakrabarti, 2015).

It is an X chromosome-linked recessive trait, and the condition is more commonly expressed in males, as it is typically inherited from mother to son (Khalaj et al., 2014). Cultural practices, such as consanguineous marriages within community groups, are an important factor in the prevalence of CVD (Kundu et al., 2018). The commonly quoted prevalence of CVD is 8% in males and 0.4% in females, although the rates vary from country to country, region to region, and even between different population groups. It can be classified based on acquired or inherited characteristics, which include monochromacy, dichromacy, trichromacy, and achromatopsia.

Some colour blind individuals do not recognize any colour s and perceive the world as gray. The use of certain drugs, as well as retinal and optic nerve diseases, may also cause colour blindness (Khalaj et al., 2014). Individuals with a colour vision defect usually have trouble discriminating between red, blue, and green colour s. These are controlled by three different genes located on Xq28, while the blue pigment gene is located on chromosome seven. Mutations and rearrangements in the genes encoding the long, middle, and short wavelength-sensitive cone pigments are responsible for CVD. One study has revealed that a missense mutation in the opsin gene leads to X-linked cone dystrophy and CVD (Fakorede et al., 2022).

2. Methodology

A cross-sectional study was conducted among schoolchildren in grades 4 to 7 (ages 10 to 13) in Bhadravati Taluk, Shivamogga District, Karnataka, India. The descriptive random sampling method was used to evaluate the prevalence of colour vision deficiency (CVD) among the samples. A total of 1,063 study participants from 9 schools were selected for the study.

The prevalence of CVD was assessed using Ishihara's colour plates, which included demonstration plates, transformation plates, vanishing plates, hidden digit plates, diagnostic plates, and tracing plates. The Ishihara test is one of the most common CVD tests, used worldwide, and this test mainly detects red-green colour blindness. For large-scale examinations, the test can be simplified to an examination of 6 plates. One from the demonstration plate, one from 2, 3, 4, 5, one from 6, 7, 8, 9, one from 10, 11, 12, 13, one from 14, 15, 16, 17, one from 18, 19, 20, 21, and one from 22, 23, 24, 25 respectively.

In this study, the researcher randomly selected two sets of plates, such as 3, 6, 11, 15, 21, and 4, 9, 13, 16, 19, respectively. The forms of CVD, such as protan and deutan, were diagnosed using the diagnostic plates numbered 22, 23, 24, and 25. The screening process from the Ishihara test among the study samples was identified by placing the plates in natural daylight at a distance of 75 cm as per the Ishihara test guidelines. The individuals were asked to observe and identify the plates accurately within 3 seconds. Hence, those who tested positive were once again diagnosed by using different plates for the confirmation, and the readings were recorded.

3. Results

Table 1: Gender Ratio of Colour Vision Deficiency in Selected Study Samples

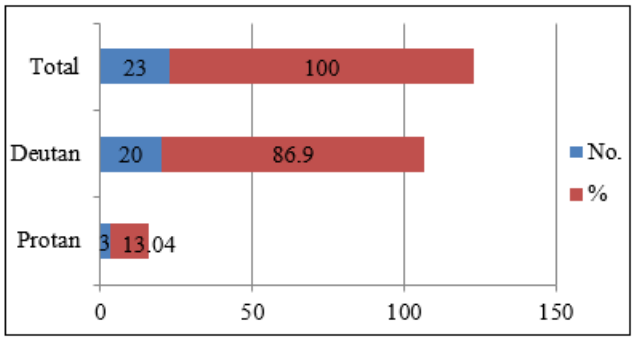
Colour Vision Deficiency	No.	%	No.	%
Affected	23	4.09	00	00.00
Normal	539	95.9	501	100.00
Total	562	100.00	501	100.00

(*Source: Primary Data/Field Data*)

Table 2: Distribution of Protan and Deutan Types of Colour Blindness in Males

Colour Vision Deficiency Types	*No.*	*%*
Protan	03	13.04
Deutan	20	86.90
Total	23	100.00

(*Source: Primary Data/Field Data*)

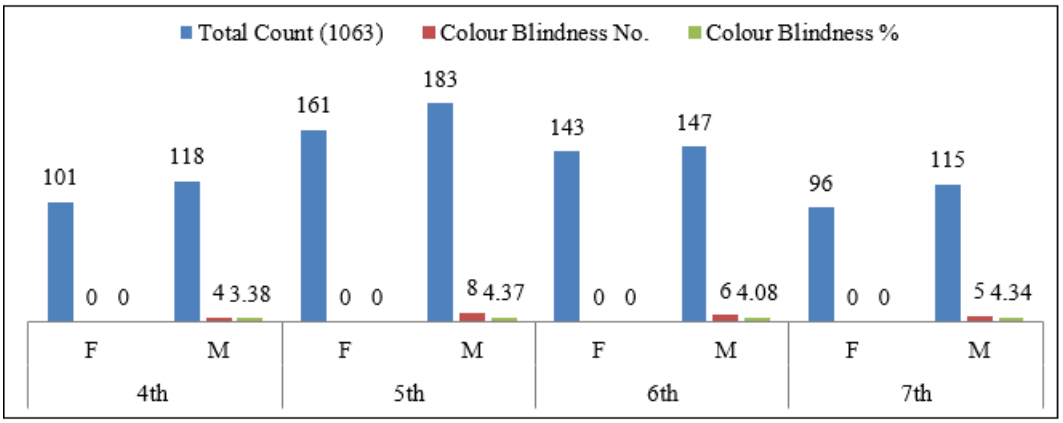


(*Source: Primary Data/Field Data*)

Table 3: Class-Wise Distribution of Colour Vision Deficiency Children

Class	Gender	Total Count (1063)	Colour Blindness	
			No.	*%*
4th	F	101	0	0.0
	M	118	4	3.38
5th	F	161	0	0.0
	M	183	8	4.37
6th	F	143	0	0.0
	M	147	6	4.08
7th	F	96	0	0.0
	M	115	5	4.34

($\chi 2$ = 19.03, df =1, and p = 0.0000129)



4. Discussions

The above table 1 explains the gender ratio of colour vision deficiency in selected study samples. It is found that among the 1,063 randomly screened CVD-screened students, 562 (56.2%) were males and 501 (47.13%) were females. After analysis, the results found that 23 (2.16%) samples were identified with CVD, all of which were males, with no females identified. The highest rate of incidence of CVD was observed in males with respect to 562 male students (4.09%). Being an X-linked recessive trait, the prevalence of colour blindness with respect to sex was found to be higher in males than females. The similar kinds of results were noticed in the studies such as Agarwal et al. (2014) and Moudgil (2016). In the Agarwal et al. (2014) study, it was revealed that a total of 12 students (2.02%) were identified with the disorder of CVD, which includes 11 boys (3.16%) and one girl (0.40%).

The prevalence rate for colour blindness was found to be higher in males (3.16%) than that of females (0.40%). Moudgil's (2016) research study also reported a prevalence of colour blindness was higher in boys (8.72%) and 0.33% in girls among young Jordanians. The average frequency of red-green colour blindness was reported to be about 8% among males and 0.4 to 0.7% among females. The above table 2 highlights the distribution of protan and deutan types of colour blindness in males. It is found that among the identified 23 colour -blind students' samples, the protan type of CVD is observed in 3 students and is denoted as protanopes (red light). Similarly, the Deutan type was observed in 20 male students' samples. Among the CVDs, 23 male samples of Deutan (86.95%) were more prevalent than Protan (13.04%).

The above table and bar graph 3 provide information about the class-wise distribution of colour vision deficiency children in the selected sample schools. Among 562 surveyed male students, 4 students out of 118 males in class 4 were identified with the disorder of colour blindness with a prevalence rate of 3.38%. Likewise, 8 students out of 183 males of class 5, 6 students out of 147 males of class 6, and 5 students out of 115 male students are also identified with

colour blind symptoms with a prevalence rate of 4.37%, 4.08%, and 4.34%.

5. Conclusion

Ishihara pseudo-isochromatic colour plates are a widely accepted method for detecting the majority of congenital red-green colour vision deficiencies. During school visits, it was observed that many children are unaware of colour vision deficiency (CVD). Students with CVD often struggle to distinguish between certain colours, which can make colour-related schoolwork and projects challenging. This difficulty may lead to feelings of self-consciousness or frustration due to their impaired colour perception. Colour vision deficiencies can also impact various industries, including paint, textiles, transportation, law enforcement, fire and rescue, and the military. In everyday situations, colour perception can be improved with the use of EnChroma glasses, contact lenses, or other specialized eyewear.

It was found that among male students, the percentage of colour blindness ranges from 3.38% in fourth standard to 4.37% in fifth standard. Furthermore, chi-square analysis reveals a strong and significant correlation between gender and colour blindness, confirming that it is considerably more prevalent in males than in females.

Declaration of Conflicting Interest: The authors declared no potential conflicts of interest with respect to the research study, authorship, or publication of this article.

Funding: The authors received no financial support for the publication of this article.

Ethical Consent and Clearance: Individual consents were taken during data collection. Before collecting personal data from each participant, researcher obtained explicit permission from them, ensuring that each person understood how their information would be used and agreed to share it voluntarily; essentially, every selected individual involved and gave their consent to participate in the data collection process.

Acknowledgement: The researcher thanks research mentor, friends Chinmayee R., Neha H. N., Vidyashree K.N., and organizations that helped for conducting research.

References

[1] Agarwal, S., & Bansod, N. (2014). Prevalence of colour blindness in school children. *International Journal of Scientific Research., 3*(4), 175-7.

[2] Chakrabarti, A. (2015). A review on colour vision deficiency. *International Journal of Recent Research in Life Sciences, 2*(3), 24-27.

[3] Fakorede, S. T., Akpan, L. G., Adekoya, K. O., & Oboh, B. (2022). Prevalence and population genetic data of colour vision deficiency among students from selected tertiary institutions in Lagos State, Nigeria. *Egyptian Journal of Medical Human Genetics, 23*(1), 1-8.

[4] Khalaj, M., Mohammadi, M., & Barikani, A. (2014). Prevalence of colour vision deficiency in Qazvin. *Zahedan Journal of Research in Medical Sciences*, *16*(1), 91-93.

[5] Kundu, B. K., & Chakma, B. (2020). Prevalence of colour vision defect in the Indian populationresults from a pre-employment screening centre of a tertiary care hospital. *International Journal of Contemporary Medical Research, 7,* 19-23.

[6] Moudgil, T., Arora, R., & Kaur, K. (2016). Prevalance of colour blindness in children. *International Journal of Medical and Dental Sciences,* 1252-1258.

[7] Reddy, A. V. P., Babu, R. G., & Prasad, V. K. (2017). Prevalence of colour blindness in school children in Guntur City, Andhra Pradesh. *International Journal of Contemporary Medical Research,4*(11), 2266-8.

[8] Shinobuishihara, M. D. (2019). The series of plate designed as a test for colour-deficiency. *Kanehara trading inc.* Japan Academy, Tokyo, Japan, 1-38.

[9] Wale, S. M. Z., Abebe, Y., Adamu, Y., & Zelalem, A. (2018). Prevalence of colour blindness among school children in three primary schools of Gish Abay town district, Amhara regional state, north-west Ethiopia. *BMC Ophthalmology, 18*(1), 1-6.