ASSESSMENT OF COLOR VISION AMONG HEALTH SCIENCE STUDENTS

Pandit R[1], Dhakal R[2]

[1]Department of Physiology, Nepal Medical College, Attarkhel, Gokarneshwor-8, [2]Shankarapur Hospital, Jorpati, Gokarneshwor-6, Kathmandu, Nepal

ABSTRACT

The synergistic and harmonic functions of retina, optic nerve, part of thalamus and visual cortex are essential for the perception of color: human color vision is trichromatic i.e. the mixture of red, green and blue lights. The present cross-sectional study was conducted in August to October 2018. The ethical approval was obtained from Institutional Review Committee (IRC) of Nepal Medical College. After obtaining consent from the participants, the study was carried out among health science students of age group 18-25 years at Jorpati, Kathmandu, Nepal. The number (n) of sample size was 300; (male, n=150, female, n=150). The assessment of color blindness was done with the help of Ishihara Chart ("Ishihara Type Tests for Color Blindness"-38 plates (2002) Eye Care- Ludhiana, India). Among the study group (male, n=150, female, n=150), the color deficiency were found in male participants only; n=7, which is 2.33% of total participants (n=300). None of the female participants were found to be color blind/weak. Among the color deficient (n=7), protanomaly detected in 1, deuteranomaly in 2 and deuteranopia in 4. Hence, the present students of health stream are future health workers, whose observation apt to clinical examination is instrumental to treat patients; therefore, they must be aware and circumspect of their color vision to discharge their duties to the patients in a better way.

KEYWORDS

Health science students, color vision, Ishihara chart

CORRESPONDING AUTHOR

Mr. Rajan Pandit
Assistant Professor,
Department of Physiology,
Nepal Medical College,
Attarkhel, Gokarneshwor-8, Kathmandu, Nepal.
Email: pandit_rajan@yahoo.com
Orcid ID: 0000-0001-9744-1248
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INTRODUCTION

Retina consists of red-sensitive L, green-sensitive M, and blue-sensitive S cones each containing a different photopigment and that are maximally sensitive to red, green and blue light respectively.[1] Color is mediated by ganglion cells that subtract or add input from one type of cone to input from another type. Processing in the ganglionic cells and lateral geniculated nucleus produces impulses that through neuronal pathways project to blobs and deep portion of layer 4C of V1 and thereby project to V8 for color sensation.[2] Therefore, the synergistic and harmonic functions of retina, optic nerve, part of thalamus and visual cortex are essential for the perception of color. Human color vision, therefore, is normally trichromatic i.e. the mixture of red, green and blue lights.[3]

John Dalton describe his own extraordinary facts relating to the vision of colors in 1798.[4] Later, after his death, DNA extracted from his preserved eye tissue showed that he was a deuteranope, lacking the middle wave photopigment of the retina.[5]

The prefixes "prot-," "deuter-," and "trit-" refer to defects of the red, green, and blue cone systems respectively. The cone pigments of red-sensitive L and green- sensitive M are encoded by genes arranged in tandem on the q arm of the X chromosome whereas the gene for the blue-sensitive S cone pigment is on chromosome 7.[2] Some color-blind individuals who are unable to distinguish certain colors knows dichromats and monochromats, whereas others have only a color weakness knows as anomalous trichromats.[2]

Aetiologically, color vision defect may be congenital or acquired.[6] Red-green perceptive disorders (protan-deutan) are X-linked recessive, but blue color perceptive disturbance is caused by a simple mutation in gene coding for blue receptor on chromosome 7.[7] Blue perceptive disorders (trit) is rare and shows no sexual selectivity.[2] whereas; the acquired deficiencies are caused by ocular and intracranial pathologies,[6] drugs, diabetic retinopathy, hypertension, glaucoma, macular degeneration and yellowing of the lens due to ageing.[8,9]

Thus, present study was undertaken to evaluate the color vision defect among health science students, the future health workers, prompting them to be circumspect regarding their color vision status and be more alert in the evaluation of colored clinical observations.

MATERIALS AND METHODS

The present cross-sectional study was carried out in the month of August-October, 2018 among health science students of age group 18-25 years at Jorpati, Kathmandu, Nepal. Ethical approval was taken from the Institutional Review Committee of Nepal Medical College. The consent from the participants was taken prior to the commencement of the study. The sample size was 300; (male, n=150, female, n=150). Individuals suffering from ocular and intracranial pathologies, hypertension, glaucoma, and under medication were excluded from the study.

The assessment of color blindness was done with the help of Ishihara Chart ("Ishihara Type Tests for Color Blindness"-38 plates (2002) Eye Care- Ludhiana, India). The Ishihara Chart plate consists of figures made up of colored spots on a background of similarly shaped colored spots. The figures are intentionally made up of colors that are liable to look the same as the background to an individual who is color blind. Participants were asked to read the number displayed in the plate keeping the chart 33 cm away from the eyes with optimum light. The types of color blind/weak were segregated with the help of key provided with the chart. All the collected data were compiled and analyzed using Excel.

RESULTS

Based on Ischihara's plates test interpretation guidelines, Table 1, the percentage distribution of color deficiency as revealed by our study is presented in Table 2. Among the study group (male, n=150, female, n=150), the color deficiency was recorded in male participants only; number (n)=7, which is 4.66 % of total male participants and 2.33% of total participants (n=300). None of the female participants were found to be color blind/weak.

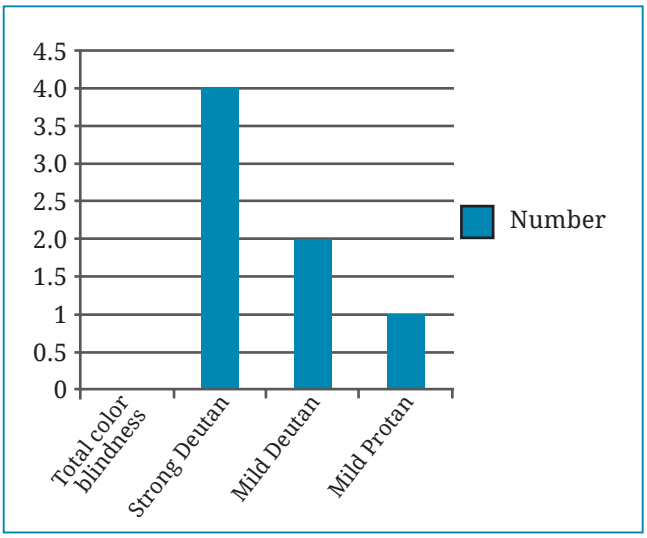

Fig. 1: Number of participants with various color vision defects

Table 1: Interpretation of Ishihara's plates test						
Number of Plate	**Normal Person**			**Person with Red-Green Deficiency**		**Person with Total Colour Blindness**
1	12			12		12
2	8			3		X
3	6			5		X
4	29			70		X
5	57			35		X
6	5			2		X
7	3			5		X
8	15			17		X
9	74			21		X
10	2			X		X
11	6			X		X
12	97			X		X
13	45			X		X
14	5			X		X
15	7			X		X
16	16			X		X
17	73			X		X
18	X			5		X
19	X			2		X
20	X			45		X
21	X			73		X
		Protan		**Deutan**		
		Strong	**Mild**	**Strong**	**Mild**	
22	26	6	(2) 6	2	2 (6)	I
23	42	2	(4) 2	4	4 (2)	I
24	35	5	(3) 5	3	3 (5)	I
25	96	6	(9) 6	9	9 (6)	I

X: The person is unable to read any number on the plate,
I: The person is indefinite in reading,
( ): the numerals in brackets show that they can be read but are comparatively unclear

Table 2: Percentage distribution of color vision defects				
Gender	**Total screened**	**Number of cases**	**%**	**Overall %**
Male	150	7	4.66	2.33
Female	150	0	0.0	

Table 3: Distribution of various types of color vision defects (Male, n=150)		
Type	**n**	**%**
Total color blindness	0	0.0%
Strong deutan	4	2.66%
Mild deutan	2	1.34%
Mild protan	1	0.66%
Total	7	**4.66%**

Table 3 depicts the distribution of various types of color vision defects. Among the color deficient (n=7), protanomaly detected in 1 participant: one participant was mild protan, deuteranomaly in 2 participants: two participants were mild deutan, and deuteranopia in 4 participants: four participants were strong deutan. Furthermore, total color blindness was not seen in our study (Fig. 1).

DISCUSSION

Red-green defects (protan-deutan) show the highest prevalence in the general population.[10] Red-green color blindness, genetic disorder, occurs almost exclusively in males. Genes in the female X chromosome code for the respective cones. Yet color blindness almost never occurs in females because at least one of the two X chromosomes almost always has a normal gene for each type of cone.[1] However, females show a defect only when both X chromosomes contain the abnormal gene.[2]

Reds, oranges, yellows, browns, greens, purples, and violets are the colors that those with 'red-green' deficiencies can fail to discriminate.[6]

Prevocational screening for the color vision deficiency is practiced for a number of occupations but, as far as is known, medical students are screened at only one university in the United Kingdom (UK)[12,13] and only at a few in the rest of the world - screening for color vision deficiency is practiced by all medical schools in Taiwan.[6] Campbell *et al*[14] found that doctors suffering from color vision deficiency were poorer detecting physical signs and were less confident about their decisions. Studies conducted by Spalding[6] (1999) and Cole[15] (2004) have reported that health professionals suffering from color vision deficiency have difficulty detecting body color changes (pallor, cyanosis, jaundice), skin rashes and erythema, Stage I pressure ulcers, blood or bile in urine, faeces, sputum, vomit, malaena, mouth and throat lesions, test strips, color coded medications, charts, slides and color sensitive monitors etc. Among the British male physicians, 8.0% were reported as color vision deficient.[6] Prevalence of color vision deficiency in Jordanians,[16] European Caucasians, Chinese and Japanese men were 8.7%, 8.0%, 4.0% and 6.5%, respectively.[17] Dargahi *et al*[18] reported that 2.4% of medical laboratory sciences students and clinical laboratory employees had color vision deficiency.

Prevalence of color vision deficiency, as reported by Shrestha *et al*[19] (2010), among the school going male students of Kathmandu Valley was 3.9%. Another study conducted by Niroula and Saha[20] (2010) among school children in Pokhara, western Nepal reported 3.8% school boys had color vision deficiency. Similarly, Pramanik *et al*[21] (2012) revealed that among 215 health science students, 5.6% of the study population was color weak/blind.

Our present study, among the study group (n=300), revealed the color deficiency only in male participants (n=7), which is 2.3% of total participants. None of the female participants in our study were found to be color deficient, corroborating with the study conducted by Niroula and Saha[20] and Shrestha *et al*.[19]

Mancuso *et al*[22] (2009) experimental study on adult red green color blind primates showed gene therapy cures color blind monkeys. However, the efficiency of the gene therapy in human is under investigation. Hopefully, this finding may provide breakthrough for treating color vision deficient individuals.

The present health science students are future health workers; therefore, must be aware of their color vision so that they can discharge their duties to the patients in a better way. Furthermore, it is also suggested that health science students should undergo their color vision test so that they will be more alert and mindful during evaluation of colored clinical observations, and if necessary must consult with their colleague in conundrum results to debar themselves from litigations, and thereby effectively align with their responsibilities as a health professional.

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