Color blindness in dental profession: An issue unexplored

Dear Editor,

Esthetics plays a vital role in achieving patient satisfaction in restorative and prosthetic dentistry. The demand of high esthetic outcomes is achieved through the production of an acceptable morphology and shade reproduction in a restoration.[1,2] Perception of color is a complex process, which depends on various factors, whereas the ability to match the shade of the required prosthesis to that of adjacent natural teeth is an important goal of restorative dental procedures.[3-5]

Color blindness, in its congenital form, is the product of genetic mutations that affect expression of three types of cone cells present in eye that respond differently to light of different wavelengths. In its genetic form, color blindness is seen as a common vision disorder, especially, seen in males (gene defect arises on X chromosome within Xq28 band).[5,6]

There is evidence to suggest that color vision is integral to a number of dental specialties, particularly, restorative and prosthetic dentistry.[7] The aim of this research was to evaluate prevalence of color blindness amongst dental professionals. Identifying and informing dental professionals with color blindness should, thus, allow the personnel to receive necessary support and training to pursue a successful career.

The present research was conducted in a cross-sectional study design that included 198 dental professionals including faculty and students who were asked to fill questionnaire followed by which their color vision status was evaluated using Ishihara test. Six color plates were shown to each subject and subjects were asked to detect numbers in color plates and write them in questionnaire provided while positive results were re-assessed for probability of being false positive by advanced examination using 17 color plates. The results obtained were subjected to statistical analysis.

The prevalence of color blindness in total sample studied was found to be around 3.54% while a general trend for increase in probability of color blindness was observed with increasing age. Also, prevalence was more in males than females and with record higher number of cases reported from faculty than students ($P < 0.05$) [Table 1].

Vision is a psycho-physical phenomenon based on sensitivity of cone cells to wavelengths between 400 and 700 nm of the electromagnetic spectrum. There are about 6–7 million cone cells in human eye which are mostly concentrated towards macula. These cells are less sensitive to light than rod cells, although allow perception of color. They are, also, able to perceive finer details and more rapid changes in images because their response times to stimuli are faster than rod cells.[8]

Because human eye usually has three kinds of cone cells with different light receptive pigments or, proteins called photopsins with different response curves, human eye is said to have trichromatic vision. These three pigments vary in their composition due to genetic influences and

Table 1: Color vision status according to age group, gender and designation in total sample

	Normal		Color Vision Defect		Total
	n	%	*n*	%	
Age group (in years)					
17-21	101	97.12	3	2.88	104
22-26	71	97.26	2	2.74	73
27-31	14	87.50	2	12.50	16
32 and above	5	100.00	0	0.00	5
Total	191	96.46	7	3.54	198
Chi-square=4.218, *P*=0.239					
Gender					
Male	49	90.74	5	9.26	54
Female	142	98.61	2	1.39	144
Total	191	96.46	7	3.54	198
Chi-square with Yates's correction=5.0120, *P*=0.0250*					
Designation					
Faculty	16	94.12	1	5.88	17
Students	175	96.69	6	3.31	181
Total	191	96.46	7	3.54	198

Chi-square with Yates's correction=0.0001, *P*=1.0000. **P*<0.05- statistically significant

thus, different individuals have cones with different color sensitivity.[9,10] Furthermore, since there are three types of cone cells responsible for spectral sensitivity for color perception, when a single type of color receptive cones are missing, it results in color blindness.[10,11]

The most commonly used tests for color vision deficiencies are the Ishihara and the Richmond HRR test.[12] Ishihara test was employed in the present research. The series of Ishihara color plates are designed to give a quick and accurate assessment of color vision deficiencies of congenital origin.[13] However, it must be noted that the ability to grade the severity of color vision defects is limited and results from such tests cannot yet be used as a basis for deciding on the severity of color vision defect.[14,15]

Numerous studies have shown that color vision defects are common amongst dental professionals including students and do affect their abilities.[3-6] The findings of this research were found to be in close accordance with the study conducted by Moser *et al*.[3] who found 9.95% prevalence and Bamise *et al*.[4] who recorded 6.3% prevalence of color blindness in their studies with reported higher prevalence in males (8.4%) than in females (3.9%).

Likewise, Barghi *et al*.[16] and Wasson and Schuman,[17] also, found similar prevalence in their studies with males being affected more than females signifying sex-linked nature of this condition analogous with the findings of present research. The present research, also, reported 3.54% prevalence of color blindness with record higher number of cases reported from males (9.26%) than females (1.39%) ($P < 0.05$).

It is of interest to note that despite color perception plays an important role in dentistry, unfortunately, not many of the dental professionals are aware of this limitation.[12] The purpose of this research was to create awareness about this type of compromise in dental professionals while they were totally unaware of it.

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Conflicts of interest

There are no conflicts of interest.

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References

1. Gokce HS, Piskin B, Ceyhan D, Gokce SM, Arisan V. Shade matching performance of normal and color vision-deficient dental professionals with standard daylight and tungsten illuminants. J Prosthet Dent 2010;103:139-47.
2. Landini G, Perryer G. Digital enhancement of haematoxylin- and eosin-stained histological images for red-green colour-blind observers. J Microsc 2009;234:293-301.
3. Moser JB, Wozniak WT, Naleway CA, Ayer WA. Color vision in dentistry: A survey. J Am Dent Assoc 1985;110:509-10.
4. Bamise CT, Esan TA, Akeredolu PA, Oluwatoyin O, Oziegbe EO. Color vision defect and tooth shade selection amongst Nigerian dental practitioners. Rev Clín Pesq Odontol 2007;3:175-82.
5. Poljak-Guberina R, Celebic A, Powers JM, Paravina RD. Colour discrimination of dental professionals and colour deficient laypersons. J Dent 2011;39:e17-22.
6. Khosla A, Maini AP, Wangoo A, Singh S, Mehar DK. Prevalence of colour vision anomalies amongst dental professionals and its effect on shade matching of teeth. J Clin Diagn Res 2017;11:ZC33-6.
7. Davison SP, Myslinski NR. Shade selection by color vision-defective dental personnel. J Prosthet Dent 1990;63:97-101.
8. Kandel ER, Schwartz JH, Jessell TM. Principles of Neural Science. 4th ed. New York: McGraw-Hill; 2000.
9. Schacter DL, Gilbert DT, Wegner DM. Psychology. 2nd ed. New York: Worth; 2011.
10. Jameson KA, Highnote SM, Wasserman LM. Richer color experience in observers with multiple photopigment opsin genes. Psychon Bull Rev 2001;8:244-61.
11. Wyszecki G, Stiles WS. Color Science: Concepts and Methods, Quantitative Data and Formulae. In: Wiley Series in Pure and Applied Optics. 2nd ed. New York: Wiley-Interscience; 2000.
12. Mushtaq F, Baraas RC, Al-Saud LM, Mirghani I, van der Zee C, Yates E, *et al*. Should prospective dental students be screened for colour vision deficits? Br Dent J 2016;221:227-8.
13. Ishihara S. Ishihara's Tests for Colour Blindness. London: Hodder Arnold; 1998.
14. Barbur JL, Rodriguez-Carmona M. Variability in normal and defective colour vision: Consequences for occupational environments. In: Best J, editor. Colour Design. Cambridge: Woodhead Publishing Limited; 2012.
15. Cole BL. Assessment of inherited colour vision defects in clinical practice. Clin Exp Optom 2007;90:157-75.
16. Barghi N, Pedrero JA, Bosch RR. Effects of batch variation on shade of dental porcelain. J Prosthet Dent 1985;54:625-7.
17. Wasson W, Schuman N. Color vision and dentistry. Quintessence Int 1992;23:349-53.

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