

ORIGINAL RESEARCH

A Study of the Prevalence of Colour Vision Deficiency (CVD) in Medical Students and its Effect on their Professional Training

Saba Faruqui¹, Rahul Jain², Akshay Harne³, Rahul Sharma⁴,
Sarika Bawaria⁵, Rahul Agarwal⁶

¹Assistant Professor, Department of Ophthalmology LN Medical College and JK Hospital
Bhopal, MP, India

²Assistant Professor, Department of Ophthalmology LN Medical College and JK Hospital
Bhopal, MP, India

³Assistant Professor, Department of Ophthalmology LN Medical College and JK Hospital
Bhopal, MP, India

⁴P.G. Resident, Department of Ophthalmology LN Medical College and JK Hospital
Bhopal, MP, India

⁵Senior Resident, Department of Ophthalmology LN Medical College and JK Hospital
Bhopal, MP, India

⁶Professor & HOD, Department of Ophthalmology LN Medical College and JK Hospital
Bhopal, MP, India

ABSTRACT

Background: The reported prevalence of colour vision deficiency in the world is 1 in 12 men (8%) and 1 in 200 women. The perception of colour is an integral part of clinical diagnosis, laboratory investigations and follows up of patients in the medical profession. We aimed to find the prevalence of colour vision deficiency (CVD) among medical students and identify the problems faced by them in their training. A cross sectional observational study conducted over 6 month's duration in a medical college.

Materials and Methods: 600 medical students aged 18-25 years were included in this study. After obtaining informed consent, and a complete ocular examination, colour vision testing was done on Ishihara's chart and students were asked to fill a questionnaire related to the problems faced by them during various stages of their training. Statistical analysis was done on JASP software. Categorical data was analyzed using Chi square test and a $p < 0.50$ was considered significant.

Results: Of the 600 students examined, 17 (2.8%) were found to have CVD, 14 males (5.3%) and 3 females (0.9%). 8 students reported minor difficulties in assessing some clinical signs, the rest were able to manage quite well.

Conclusion: The presence of colour vision deficiency, although rare, could pose a challenge to medical students in identifying important signs and lead to possible errors in diagnosis. There is a need for screening and specialised training modalities to help them overcome this difficulty.

Keywords: Colour Blindness, Colour Vision Deficiency, Ishihara Charts.

Corresponding Author: Dr Rahul Sharma, Resident (MS Ophthalmology), Department of Ophthalmology, LN Medical College and JK Hospital Bhopal, MP, Email: rsharma19942611@gmail.com

INTRODUCTION

Colour vision is the ability to discriminate between different colours and is attributed to cones in our retina being excited by light of different wavelengths. Normally colour vision is

trichromatic, i.e., three primary colours red, green and blue are appreciated and the rest are perceived by the fusion of these primary colours in different proportions. The inability to perceive one or more colours is called Colour blindness (anopia), while defective perception is called colour vision deficiency (anomaly).^[1] It may be congenital which is X linked recessive, or acquired which is due to various eye disorders, systemic disorders or drugs. CVD being asymptomatic mostly goes unnoticed. But certain activities that require interpretation based on colour may pose problems for persons with CVD. In the medical curriculum several investigations and clinical signs are based on interpretation of colour. Campbell et al,^[2] in 2005 found that medical students with CVD were unable to identify microbiological slides stained with Zeihl- Neelsen stain. Similarly, they had difficulty in identifying pictures of stool or vomitus showing fresh blood or skin rashes. The various problems reported by medical professionals and students have been summarised in [Table 1].^[3-6] In our study we aimed to assess the prevalence of this problem in our students and find out what difficulties if any, they were facing in their learning and training.

MATERIALS & METHODS

This study was carried out over a period of 6 months from July 2021 to January 2022, in the Ophthalmology department of a medical college with a sample size of 600. Male and female medical students aged between 18-25 years and giving consent to participate were included in the study. Those not giving consent or diagnosed with any ocular infections, optic nerve or retinal pathology were excluded. After obtaining approval from the institutional ethics committee and informed written consent from the participants, a complete ocular examination was carried out which included visual acuity on Snellen's chart, intra ocular pressure with non-contact tonometer, slit lamp examination and fundus examination by indirect ophthalmoscopy. All medical students aged 18-21 years of either gender enrolled in the first and second years of medical college were included in this study. The examination was performed during daylight. Ishihara plates were placed at a distance of 75 cm from the subject and tilted so that the plane of the paper lies perpendicular to the line of vision. Students were given five seconds to read the plate and one examiner was instructed to mark the checklist. A score of less than 12 out of 14 red/green test plates (not including the demonstration plate) was considered as a CVD. Each eye was tested separately. If the participants were able to identify less than 12 out of 15 plates, they were labelled as CVD, while a score of more than 12 was considered normal. A pre-designed questionnaire based on a previous study by Alharfi et al was filled by the students, containing questions about whether or not they faced difficulty in identifying various diagnostic signs such as erythema, pallor, cyanosis, microscopic and histopathologic slides, test strips and coloured charts and diagrams. [7,8]

RESULTS

Out of 600 students selected for the study, 264 (44%) were males and 336 (56%) were females. The mean age was 21.27± 0.87 years. CVD was found in 17 participants hence the prevalence of CVD was found to be 3 %. [Figure 1] Among those with CVD, 14 (5.3%) were males and 3 (0.9%) were females. [Table 2] The difference was found to be significant with a p value of 0.001. All the participants had red green colour blindness. None of the participants were found to be totally colour blind.

Table 1: Common Signs/Clinical Tests That Cause Difficulty for CVD Affected Medical Professionals

Diagnostic element	Examples
Body colour	Cyanosis, pallor, icterus
Rashes	Erythema, rubella

Body fluids/products	Urine, vomitus, bile, stool
Ophthalmoscopic findings	Retinal haemorrhages, optic disc pallor, papilloedema
ENT findings	Blood/wax on tympanic membrane
Microscopic stains	Zeihl- Neelson, Eosin
Diagnostic test strips	Urine, blood glucose

The table shows the common areas in medicine where CVD students face difficulty in identification or diagnosis.

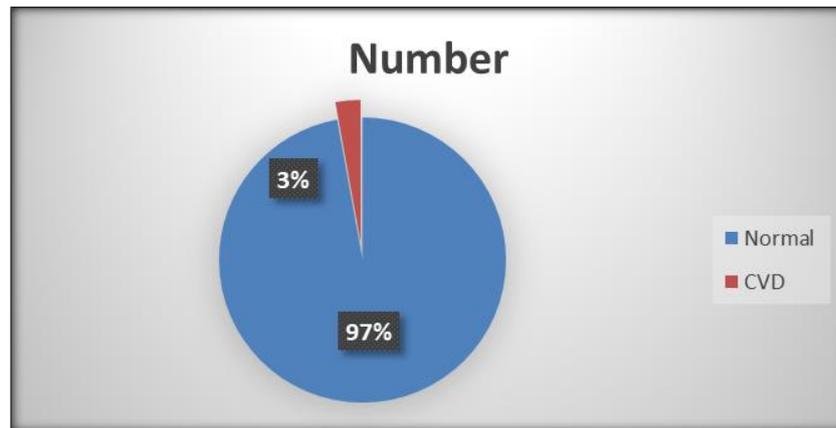


Figure 1: Prevalence of CVD

Table 2: Demographic Data

Gender	Total No. (%)	Normal vision No. (%)	CVD No. (%)	P
Males	264 (44)	250 (94.6)	14 (5.3)	0.001147
Females	336 (56)	333 (99.1)	3 (0.9)	

A significant difference was noted in the prevalence of CVD among males and females, $p < 0.05$ considered significant, calculated by Pearson Chi square test. The problems faced by medical students in their training are represented in [Figure 2]. The main difficulty reported by the students was in microscopy especially with certain dyes and stains like eosin and Zeihl-Neelsen in 47%, followed by identification of body colour changes such as erythema, cyanosis or rashes in 41.2%. However, these problems were not very severe. 9 out of 17 students (53%) with CVD did not report any difficulty.

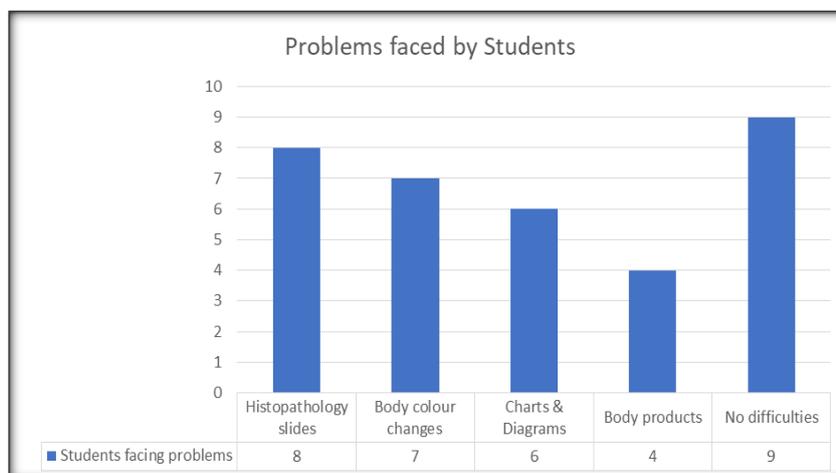


Figure 2: Problems Faced By Medical Students in their Clinical and Academic Activities

The most common difficulties encountered by medical students during their training.

Statistical analysis:

The collected data was summarized by using frequency, percentage, mean & S.D. To compare the qualitative outcome measures Chi-square test or Fisher's exact test was used. To compare the quantitative outcome measures Independent t test was used. If data was not following normal distribution, Mann Whitney U test was used p value of <0.05 was considered to be statistically significant. **Statistical analysis was done on JASP software.** Categorical data was analyzed using Chi square test and a $p < 0.50$ was considered significant. All the data was entered on an Excel sheet and analysed on JASP software. Descriptive data was collected as counts and percentages. Pearson's chi square test was used to find any associations. $P < 0.05$ was considered significant.

DISCUSSION

CVD is an asymptomatic and often undiagnosed problem. The reported prevalence of this condition varies from 2% reported by Bhatti et al.^[9] 4% reported by a study from Nepal^[10] to 12%^[11] and 8.7%^[12] reported by studies from the US and UK respectively. The current study found a prevalence of 3% which is closer to other Asian studies. The differences found among the studies could be due to the genetic variations in study population and inclusion criteria. It has been clearly shown by most studies that inherited colour blindness is more common in males as compared to females.^[13-15] Our study also showed that males (5.3%) were more commonly affected than females (0.9%). This difference was found to be statistically significant.

Among our study participants, 53% with CVD did not report any difficulty with their routine clinical and academic work. The most common areas of difficulty reported by the students were microscopy, clinical examination and study of charts and diagrams. This is in accordance with a previous study by Spalding et al where difficulties in identifying histopathologic slides were the most commonly encountered problem. Other studies have also shown problems in biochemical analysis,^[16] microscopy^[17] and histopathology.^[18] Because of the complexities involved in medical diagnosis it is not easy to prove that an error in diagnosis may be because of the clinician's defective colour perception.^[19]

Though colours are used for important signs in the medical profession, screening for colour blindness is not paid attention at beginning of a medical career. This study by Bhusal P et al was aimed to assess the presence of colour blindness, if any among the medical students of Chitwan Medical College. Among 220 participants, 5(2.27%) were found to have colour vision deficiency. Out of 5 colour deficient students, 4 of them were red-green colour vision deficient and 1 of them couldn't appreciate colour (total colour blindness) within the speculated time for the test. Female participants didn't have colour vision deficiency while colour vision deficient students were unaware of their colour vision status. It was concluded that colour vision deficiency affects male than female. Medical students should be screened for colour vision deficiency and made aware of their limitation so that they can take special care in their future clinical practice.^[20]

With the introduction of OSPE / OSCE in university examinations in Pakistan at undergraduate and postgraduate levels, the students with CVD may feel difficulty in identifying colour slides, lab instruments, specimens and examining patients leading to failure in the examination so this study by Mughal IA et al was aimed to find out the incidence of CVD in medical students. Among 750 boys, 18 were colour deficient (2.4 %). Among 1250 girls, 56 were colour deficient (4.48 %). These results are discussed in relation to other studies and data on colour vision. With this incidence of colour vision deficiency, the students with CVD may feel difficulty in identifying colour slides, lab instruments,

specimens and examining patients leading to failure in examination and difficulty in medical practice.^[21,22]

Agarwal M et al studied prevalence of colour vision deficiency (CVD) in students of medical college and to assess whether colour blind medical students face any problem in their medical training and profession. Color vision deficiency (CVD) constitutes one of the frequently observed eye disorders in all human populations. Color is a prominent sign utilized in the medical profession to study and identify histopathological specimens, lab instruments, and patient examination. Color deficiency affects the medical skills of students resulting in poor clinical examination and color appreciation. There is no effective screening of CVD at any level of the medical profession. Hence, this study was aimed to determine the prevalence of CVD among medical students.^[23]

Aziz MZ et al also studied prevalence of color vision deficiency among medical students. This was a cross-sectional study conducted from September 2019 to February 2020 over a period of six months in Karachi, Pakistan. The mean age of the medical students was 19.61 ± 1.22 years. There were (n=123) 53.0% females and (n=111) 47.0% males. Most of the medical students (n=131, 56.0%) belonged to the upper-middle-class socioeconomic group. CVD was observed in (n=13) 6.0% of medical students. Age (p=0.001) and socioeconomic status (p=0.001) were the only demographic factors significantly associated with colour deficiency. Conclusion was colour deficiency, although an unnoticed concern is fairly common among medical students. Medical students must be screened for CVD as this will enable them to be aware of their limitations in their future observational skills as a doctor and devise ways of overcoming them in clinical practice.^[24]

It is a well-known fact that many individuals with CVD learn to rely on their intuitions and other cues in an attempt to adapt to their deficiency. Despite that, they may still be at risk of missing or incorrectly diagnosing certain conditions which could have devastating consequences. Till date although medical students are often required to undergo a complete ocular examination including colour vision, at the time of their admission in the medical course, no special counselling or guidance is offered to help them in their choice of speciality in future.

CONCLUSION

In this study it was noted that most students who suffered from CVD were either not aware of this issue or were facing minor problems which they did not report to their teachers or mentors. This calls for a need for routine screening at the time of entrance into the medical course, and subsequent counselling of the affected students so that they may be made aware of the challenges that they may face and thus make a more informed career decision. An attempt can also be made to incorporate special teaching aids and technology in the diagnostic and academic field to help the CVD affected medical personnel in their routine clinical activities.

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