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Color vision deficiency in MBBS students of Rehman Medical College, Peshawar, Pakistan

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ABSTRACT

Introduction: Colors play an important role in the medical profession, but currently there is no screening for Color Vision Defects (CVD) at any stage during the education and practice of medical professionals. This deficiency, if present in students, may affect their slide / specimen identification and patients' examination hence leading to disappointment in assessment.

Objective: To document the frequency of color vision deficiency among newly admitted MBBS students of Rehman Medical College, Peshawar, Khyber Pakhtunkhwa, Pakistan.

Materials & Methods: Screening for CVD was performed during the pre-admission health screening (Nov-Dec 2018) on 88 out of the 100 new 1st year MBBS students who volunteered for the study; there were 54 males (61.4%) and 34 females (38.6%) of ages 18-21 years. The CVD was determined by using the 24-plate Ishihara's Test of Color Vision using standard techniques. Descriptive data analysis was done through SPSS 22.0.

Results: Color vision deficiency was found in 03 (3.41%) male students (5.6%), while none of the girls had CVD. All the 3 students were red and green color deficient.

Conclusion: Red green type of CVD was present among males only, probably due to X-linked inheritance, and could hamper their academic performance and career options.

Keywords: Color Vision; Color Vision Defects; Vision Tests; Retinal Photoreceptor Cells.

The authors declared no conflict of interest. All authors contributed substantially to the planning of research, data collection, data analysis, and write-up of the article, and agreed to be accountable for all aspects of the work.

INTRODUCTION

Hue, intensity and saturation are the three attributes of colors.[1] People suffering from color blindness are not completely blind hence color vision deficiency (CVD) is a suitable term for it. John Dalton was the first person to write an article on CVD, he was suffering from this deficiency himself, so CVD is also known as 'Daltonism', after John Dalton.[2] In color vision deficiency, disturbances in color perception occur if quantity of pigments is reduced per retinal cone cell or if there is absence of one or more cones of the three cone systems. Extensive focus on CVD arose after John Dalton's own Duetan (middle wave) defect explanation.

Standard vision is tricolor, with Red, Green, and Blue as the primary colors.[1] Thus, CVDs are of four varieties: Achromatopsia (total absence of color vision), Tritan (blue or short wave), Duetan (green or middle wave), and Protan (red or long wave). Visual system is proficient to differentiate colors by relating the rates of immersion of photons. The inability to differentiate identical colors from others arises due to nonexistence of a specific color receptive cone.

Photoreceptors for vision are present in the retina as Rods (for night vision) and Cones (for color and daylight vision).[1] Cones are for three primary colors which are blue, green and red; perception of these depends on stimulation of diverse wavelengths of light.

People suffering from CVD cannot differentiate between different spectral colors under normal lighting conditions.[3] Color vision abnormality may be inborn / congenital (CCVD) or developed / acquired (ACVD). In overall population congenital CVD occurrence for males is 8% and in females is 0.4%;[3] however there are wide variations across different regions of the world.

The genes for the Red and Green color cones are located on the X chromosome, hence such deficiency is transmitted in an X-linked recessive manner; the gene for Blue color cones is located on chromosome 7, hence blue color deficiency is autosomal dominant, and can occur by simple mutations in the gene coding for blue receptors.[3]

Lack or defect of one or more than one prime cone leads to congenital color vision deficiency (CVD), a nonprogressive and persistent condition.

As for the acquired CVDs, it is considered to be a work-related global danger where severe complications can happen in day-to-day life.[4,5] The developed deficits are due to ocular and intracranial pathologies, drugs, hyperglycemic retinopathy, high blood pressure, increased intraocular pressure, macular erosion and opacity of the lens due to ageing, of which most are Tritan.[6] Age-related acquired deficiencies perhaps occur with greater frequency than the inborn ones; moreover, in the elderly there is an association between auditory and visual damage, so that finding a deficiency in one domain (visual) indicates an increased chance of deficiency in the other domain (auditory).[7]

CVD affects career choice, job performance, and gives rise to a number of social and psychological problems for the handicapped.[8] Health professionals are also prone to CVDs like other professions.[9,10] Studies have described common problems faced by medical students, practitioners, and other healthcare professionals suffering from CVD; generally, such medics were less confident about their decisions because of problems in identification of physical signs and naming of colors. If CVD is not tested both primarily and regularly, so the patients' safety is potentially endangered. Since the correct perception of color is very important in healthcare there can be a direct bearing on the professional competency of such CVD affected medical personnel; they have trouble identifying body color variations during General Physical Examination of patients, skin eruptions and redness, Stage I pressure bed sores, different colors of body secretions, different conditions related to oral cavity and throat, color coded drugs, graphs, photos, patterns, and color sensitive screens etc.[9-12]

In the UK, screening of medical undergraduates for hereditary color vision deficiency is practiced at only one university;[6,10] only a few other places practice it globally as well. In medical education with the initiation of OSPE/OSCE, students with color vision deficiency may sense complexity in recognizing color slides, lab tools, samples, and inspecting patients, leading to disappointment in the assessment.[6,10] Attempts have been made to provide alternate means to color blind medical students so that they are able to continue their studies, e.g., website based information,[12] and help in recognizing histology slides[13].

Role of color discrimination is very important in healthcare settings. Lack of awareness about healthcare workers with CVD may jeopardize the safety of patients.

A number of screening tests are employed to detect the condition. These include the Ishihara test, the Richmond HRR test, the Medmont C-100 test, and the Farnsworth D15 test.[14] Each has merits and demerits, but overall the Ishihara test is preferred for quick screening due to its ease, inexpensiveness, and robust sensitivity.

The present study was carried out to document the occurrence of color vision deficiency in students seeking admission to the MBBS course in a private medical college of Peshawar, Khyber Pakhtunkhwa, Pakistan.

MATERIALS & METHODS

Out of a total 100 medical students inducted in first year MBBS at Rehman Medical College (RMC) at the start of academic session 2018-2019, 88 students volunteered to participate in the study after informed consent. Students were examined for CVD in Executive Health Checkup; vision tests were performed during their preadmission health checkup (Nov-Dec 2018).

The inclusion criteria were 1st year MBBS students not having any ocular defect.

The tool was Ishihara's Test (24-plate) of Color Vision Deficiency[15] and it was kept at a distance of 75 cm from the students with a right-angle slant to the line of vision. Well illuminated room was used for performing test. Each plate was shown only once for 3-5 seconds.[15] Color vision was considered normal if 13 or more plates were read properly. Red Green color deficiency was considered if the plates read correctly were 9 or less. The plates 16 and 17 were used to distinguish Protan and Deutan form of deficiency of color vision.

Data of each student was collected on a standardized structured Performa Descriptive data analysis was performed through SPSS 22.0.

RESULTS

A total of 88 students of age group 18-21 years were tested. The CVD frequency in the subjects is shown in Table 1. All the color deficient were in the Red Green Color–deficient category.

Table 1: Difference in prevalence of red-green color vision deficiency (CVD) in students

Type	Number	Percentage
Normal color vision	85	96.6
CVD Red-Green Color Deficient	03	03.4

Gender wise distribution of CVD is shown in Table 2. Out of 34(38.6%) females, none was color deficient. Out of 54(61.4%) males, 03 were color deficient (5.6%).

Table 2: Frequency of CVD in first year medical students of Rehman Medical College (n=88).

Subject	Number	Percentage
Females (n=34)	0	0
Males (n=54)	3	5.6

DISCUSSION

Diagnosis of color vision deficiency among the medical students can be difficult. Pre-admission eye screening can play an important role in identification of students with these deficiencies.[16,17] In the current study, CVD occurred in in 3.4% of 88 tested first year medical students, amounting to 5.6% of males (54) only. It confirms previous results indicative of X-linked recessive manner inheritance of the condition. The data are also in line with previous national and many international studies, that show that a minor proportion of males have red-green CVD.[5,18-20]

The current study differs considerably from a previous study from Faisalabad, Pakistan,[6] where, out of a total of 2000 first year medical students tested, 2.4% of males and 4.48% of females were identified with CVD; this may partly be explained by the difference in sample size, but the high frequency in females merits further investigation into the genetics of transmission. Moreover, a study from India on a large sample of 500 medical students, of which 315(63%) were females and 185(37%) were males, also supported the finding that males were more prone to CVD, in that 1.6% of males and 0.2% of females had the condition despite the disproportionate female to male ratio.[21]

Color vision deficiency can cause severe disabilities in various occupations, and medicine is one of them. CVD is a known risk for drivers leading to accidents, and be associated with several important psychosocial issues in everyday life, education, career choices, job performance, etc.[22] It can cause complexity in doing everyday work and in printed materials and color display. In several research studies on medical students and doctors with CVD, it was revealed that their educational expertise and job performances were decreased compared to controls.[6,9,10,23] Astonishingly medical personnel are usually unaware of suffering from CVD, because in most countries screening policies usually do not present, counting the UK.[10,22] Medical students and doctors should go through screening for CVD to avoid any risk, as recommended. Different studies from around the world on color blindness have fairly similar conclusions and recommendations on this aspect.

The outcomes of this study are in accordance with a study on young Turkish boys having inherited color blindness,[19] although they have stated a greater occurrence (7.3%). In the UK studies, 8% prevalence has been reported in males, however, in a bigger study, the occurrence was 6.7% in males. 8.7% and 8.2% prevalence in a data from Jordan[20] and India.[21] An extensive review from Singapore[24] discusses the prevalence of CVD among different types of healthcare professionals and also describes the problems faced by them during their occupations. Overall, the results of the present study correlate with studies done throughout the world which show higher rates of CVD in males, with red-green predominance.

In the medical field there are no elimination criteria for CVD, though there have been color vision necessities for medical courses in Japan, but labors to reduce these began in the late 1980 and it seems they have been successful.[25] Occurrence of CVD in overall population and Medical personnel are similar. Medical errors should be viewed keenly because they are not rare and have a diversity of causes. To minimize the error, it should be recognized first and should find the solution to avoid it. This should be applied to people causing errors due to CVD. Doctors can avoid errors by choosing their specialty carefully and according to their necessities; utilizing sources of information that do not depend on color; and making sure they have good observation conditions, especially adequate illumination.

The western world has a proper system for screening and awareness of CVD. In Pakistan, the situation is totally different; there are no proper programs for screening in medical schools. A lot of planning and programming is needed for competition at limited career facilities. The main problem in Pakistan is job insecurity and absent health and insurance policies. Second most important cause is lack of money and resources.

LIMITATIONS

Only 1st year MBBS students were screened and rest of the students were not included in the study. It was decided to detect and record only red-green CVD. This technique of CVD arrangement has its disadvantages, though it was easy to measure with the Ishihara chart and is more commonly used.

CONCLUSION

Detection of Color Vision Deficiency as a screening tool is likely to detect covert cases and help in better management of these individuals during their educational progress, job performance and career selection.

RECOMMENDATIONS

Awareness and screening schemes for CVD should be planned which would help in choosing better and suitable careers. Advanced studies should be carried out at the time of admissions to medical school and students should choose their specialty according to the severity of their CVD. Further on-job evaluations to identify job incapacities in individuals having CVD are suggested.

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