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FREQUENCY OF COLOR BLINDNESS AMONGST THE YOUNGEST AGE GROUP IN SOUTHERN PUNJAB PROVINCE OF PAKISTAN

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ABSTRACT

Objective: To determine frequency of color blindness and to assess self awareness regarding this ailment amongst the youngest age group in southern Punjab province of Pakistan.
Study Design: Cross sectional study.
Place and Duration of Study: Combined Military Hospital (CMH) Bahawalpur, from Jan 2016 to Jun 2017.
Patients and Methods: Non probability consecutive sampling was done. Candidates who appeared for medical fitness examination were included; all of them belonged to the southern Punjab province of Pakistan. Visual acuity and best corrected visual acuity was assessed. Color vision was checked by using Ishihara color vision charts. Anterior and posterior segment examination of eyes was carried out.
Results: Total 1000 candidates underwent color vision assessment. Overall 3.1% (31/1000) of the candidates were found to be color vision deficient. Out of them, 93.54% (29) were unaware of their condition.
Conclusion: The screened population showed color blindness to be present in 3.1% of the candidates. Most of the individuals were unaware of the condition.

Keywords: Color blindness, Screening.

INTRODUCTION

Tricromatic vision is one of the human distinguishing features from other primates. It requires at least three photopigments of well separated spectral classes. Three classes of pigments differ in their relative spectral sensitivities and are referred to as red, green and blue pigments. There are three types of color vision genes. Red and Green pigment genes are at long arm of chromosome Xq-28 while blue pigment gene is on chromosome 7[1]. "Color blindness" is an art term, there is no actual blindness, but there is faulty development of one or more sets of retinal cone photoreceptors. Color vision deficiency is one of the commonest visual disorders and can be either congenital or acquired. Congenital deficiency is X chromosome linked recessive, autosomal dominant and very rarely autosomal recessive trait[1]. Since the X linked deficiency is the most common form so it is more common in males. Acquired causes of color blindness include damage to eye, nerve, brain; some metabolic disorders such as diabetes, glaucoma, macular degeneration; chronic illness like sickle cell anaemia; even exposure to industrial toxins or drug over dose such as digoxin, barbiturates, anti-tubercular drugs or drug side effects like Sildenafil, Ethambutol, Chloroquine etc[2]. Color blindness is often a handicap in everyday life. Although it is not very rare still most of the patients with color vision deficiency are not aware of their condition and it remains an unnoticed problem. This results in various problems such as disability in job (25%), career selection (33%), judgment in daily routine (75%) and traffic signal recognition (13%)[3]. Color vision standards are established in army, aviation and railway fields; however for health care professionals and drivers of motor vehicles they have not yet been effectively adapted. The UK health and safety executive advise that there are certain occupations which require normal color vision for the purpose of safety or quality of product. For a color blind person safety is at risk in certain professions like armed forces,

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railway, merchant shipping, railway, navigation, civil aviation, hospital technician, pharmacist, police and fire services etc. Quality of services will be compromised in certain jobs like color matching in textile, printing and dyes, chemical analysis using colors, horticulture, fine arts and color photography etc[4]. Prevalence of color vision deficiency varies in different countries and populations. Few of the prevalence studies have shown it to be Turkey 7.3%, Iran 4.7%, India (2.8%-8.2%) and Saudi Arabia 2.9%[5]. There is scanty data available in Pakistan and population based studies are lacking. The medical fitness examination of the candidates applying for selection carried out in hospital. All of the candidates appearing here belong to the southern Punjab province. The purpose of our study was to find out frequency of color vision deficiency in this area of Pakistan.

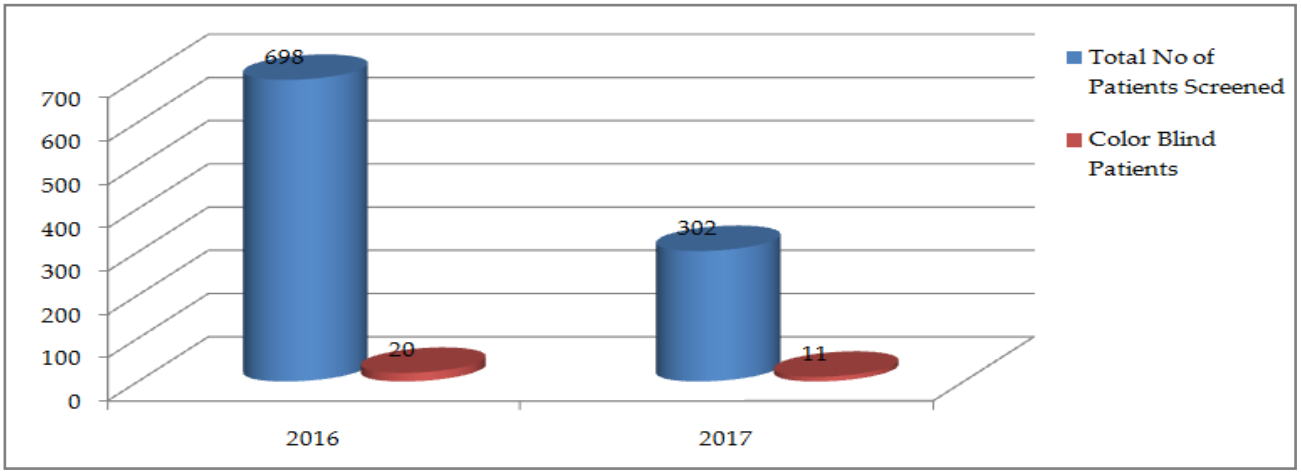

Figure: Frequency of color blindness from Jan 2016 to Jun 2017.

PATIENTS AND METHODS

This cross sectional study was carried out at CMH Bahawalpur after approval from ethical review committee. Using WHO sample size calculator, keeping confidence level 99%, anticipated population proportion 0.05 and absolute precision required 0.02, the sample size calculated was n=1000. The study included all individuals who applied for medical fitness examination at Eye dept. Exclusion criteria included the individuals with history of ocular or neurologic surgery, anti-tuberculosis or central nervous system drugs. No individual was fit on these criteria. It was a non probability consecutive sampling. Informed consent was taken. Unaided vision and best corrected visual acuity was assessed. Color vision was assessed with the best correction in trial frame. Ishihara isochromatic color plates were read by each candidate held at 75cm in front, perpendicular to the line of vision in a well illuminated place. Each plate was presented for three to five seconds and candidate was requested to read the number. The candidate who read all the plates properly were considered normal while those who could not read the plates accurately were considered to be color vision deficient. Slit lamp biomicroscopic examination of anterior and posterior segments of both eyes was carried out. The data were entered and analyzed in SPSS version 22. Descriptive statistics were used to calculate mean and standard deviation of age. Percentage was calculated for the presence or absence of color blindness and awareness of this ailment.

RESULTS

A total of 1000 candidates underwent color vision assessment from January 2016 to June 2017 (figure). All of them were male. Mean age of the candidates was 23.74 ± 3.53 years. Overall 3.1% (31/1000) of the candidates were found to be having color vision deficiency (table). Out of them, 93.54% (29) candidates were unaware of their condition.

DISCUSSION

Color vision deficiency or color blindness is reduced ability to perceive colors[6]. It normally does not affect the visual acuity so most of the times it remains unobserved. Color vision pertains to the cone photoreceptors. There are three types of retinal cones; each of them has specific peak sensitivity for light wavelength like blue at 414-424 nm, green at 522-539 nm and red at 549-570 nm[7]. Normal color perception requires all these primary colors to match those within the spectrum. Color vision deficiency develops when any given cone pigment is either deficient or absent. There are various tests being used to assess color vision. Commonly used tests are Ishihara test, Fransworth-Munsell 100-hue test, Hardy-Rand-Rittler test and City University test.

Table: Frequency of color blindness by age group.

Age group, years	Screened	Candidates with color vision deficiency	
		Frequency	Percentage (%)
≤24	735	23	3.1
≥25	265	8	3.01
Total	1000	31	3.1

Ishihara test is designed to screen for congenital color vision anomalies; it is simple and available widely and so is frequently used in practice[7]. It consists of a test plate followed by 16 plates, each plate has a matrix of dots arranged to show a central shape or number that the subject is asked to identify. Normal subjects will be able to read all the numbers while the color deficient person can identify only some of the figures. Color blindness has significant impact on the quality of life for health, emotions and particularly for career. The prevalence of congenital color blindness has been found to be variable in different geographical setups[8]. Internationally reported color vision deficiency among male population is 8% in Belgium, 8% in United States, 7.33% in Turkey, 6.5% in China and 8.73 % in Indian population[9]. There is lack of population based studies in Pakistan. Color vision deficiency reported from various areas of Pakistan has shown to be 5.1% in Rawalpindi, 1.41% in Karachi.[6,10]. Hamida reported overall color vision deficiency to be 2.48% in the population of Quetta and Siddiqui *et al* however found color vision deficiency among Pakistani students from various institutions to be 2.75%[11]. These results are comparable to our study.

Color vision is integral for visual world understanding, individuals with deficiency can encounter difficulties in everyday life. These individuals are at a disadvantage with comparative color tasks which involve precise colors matching or discrimination of fine color differences, this is either because of their loss of color discrimination or anomalous perception. The majority of them have problems when information is coded with colors, in man-made color codes and in naturally occurring color codes that signal ripeness of fruit, meat freshness or illness etc. They may be unreliable when a color name is used as an identifier[3]. There are certain occupations for which proper color identification is must e.g. laboratory technicians, driving, navigation, Merchant shipping, Electrical contracting etc. health care professionals face difficulties in identifying change in body color, erythema, cyanosis, jaundice and palor[12]. Knowing of color vision deficiency at earlier age is essential for selection of profession with less color vision requirement. In this study 93.54% of the candidates were unaware of their color vision deficiency. This is comparable to an international study which showed that 96% of color blind students attending middle school were unaware of anomalous vision[13] in another study it was found that 65% of the university students did not know about their anomalous vision[10].

Being diagnosed can help people to identify where they might need to ask for assistance to avoid making mistakes or being misunderstood. Hossein Darghai in a study at Tehran University

of medical sciences concluded that individuals with color blindness should be restricted from employment as laboratory technician and technologist. There are increased chances of potential error in the practice of laboratory diagnosis and techniques[14]. Awareness of their deficiency at an earlier age will allow them to adapt a profession with low need of color vision. Congenital color blindness is a non pathologic condition; it is in curable and remains constant throughout life. In the past various therapies have been proposed like electrical eye stimulation, high doses of vitamins and iodine injections etc. but none of them proved to be beneficial[15]. Some optometrists gave colored spectacle lenses or a single redtint contact lens to be worn over the non-dominant eye, these lenses change the wave length of each color entering into the eye, enabling the individual to see more colors. Although that improved discrimination of some colors but made other colors more difficult to distinguish[16]. There are some applications of iPhone and iPads which enable color blind people to see in a better way. There are certain cameras which allow correction of image taken with a special daltonizer algorithm. Eyeborg is a cybermetic device which allows the wearer to hear sounds representing different colors[17]. The experimental gene therapy for color blindness aim to convert congenitally color blind individuals to trichromats. In gene therapy a functional copy of gene is introduced into the patient's own cell, it is able to produce normal proteins which have potential to correct the underlying cause of disease[18]. Animal studies have shown that by injecting a gene of missing photopigment it is possible to confer color vision, however till now these studies have not yet been demonstrated in humans. Screening of students make them aware of their limitations in power of observation hence enable them to device the ways to overcome them. This allows them to choice profession hence reducing anxiety and enhancing confidence. This study can raise awareness about color blindness among the population, and enlighten affected individuals of possible career options.

CONCLUSION

The screened population showed color vision deficiency to be present in 3.1% of the candidates. Most of the individuals were unaware of the condition.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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