

INCIDENCE OF COLOR BLINDNESS AMONG UNDERGRADUATES STUDENTS OF MEDICAL COLLEGE IN POKHARA

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ABSTRACT

Introduction

There are many genetic disorders that are X-linked, one being the color blindness. Some individuals affected with the disorders may remain unaware till detected for a long time. There are very few reports about the incidence of the color blindness among the medical undergraduate students.

Objectives

Objective of our study was to assess the color blindness incidence, among the medical undergraduates at the Gandaki Medical College, Pokhara.

Methodology

We piloted an observational cross-sectional study among the first and second year medical students (MBBS, BDS, Nursing, and paramedics) at Gandaki medical college. We finalized 300 students of both the genders based on the inclusion criteria. We performed in the natural day light, the color vision test using the Ishihara plates. We assessed incidence, the type of the color blindness and the gender distribution among the subjects. We compared the data thus obtained applying the "chi square statistical test" deliberating $p < 0.05$ as significant.

Result

We observed that all the color blind subjects in the study were male who constituted 2% of the all the subjects. There was significant difference statistically among the types of the color blindness with majority having Deuteranomaly.

Conclusions

We can conclude that incidence of the color blindness was exclusive among men in our study. Total color blindness was seen in majority of the male subjects. Screening the students will enable the unaware students of their disability and hence they can be guided to proper counseling.

KEY WORDS

Anopia, Color Blindness, Color Vision, Medical Students.



INTRODUCTION

Among the various types of the diseases that are inherited, “color vision deficiency/ color blindness” is a comparatively common occurrence of the ophthalmological diseases. The inability to differentiate the colors is named as color vision deficiency/ color blindness.¹ The retinal receptors, i.e., rods and cones help in the color appreciation. The affected individual have disability with learning and identification of the colors.²⁻⁴ This disease is caused due to the flaw in the cones of the eye. The deficiency may be in all the three types of the cones or any one of the types of the cone. Human eye possess the trichromatic vision i.e., the vision is a mix of the blue, green and the red lights.² Based on the type of the color combination deficiency, color blindness is further categorized as three types. The most common is the red-green color blindness.²⁻⁵

The incidence of this disease is usually seen in the men compared to women.¹ Among common population in the world, color blindness affects approximately 8% in male and less than 1% in females.⁴⁻⁶ Though this disease is relatively common it may be undiagnosed till a later stage of the life or the individual may be some times totally unaware his entire life. This could be due to the mild nature of the disease and the adaptation of the individual to the surroundings. The affected individuals have to refrain from jobs that involve a significant identification of the red and green colors. Detecting the disease early may aid the individual from choosing a career that involves no great role of color.^{1,7-9}

Some tools used to evaluate this defect in clinical practices are appropriate for primary care physicians. “Ishihara plates test”, which detects deutan and protan defect, is used for all new patients, in addition to “Richmond Hardy–Rand–Rittler (HRR) test”, that identifies Tritan defect is the ideal confirmatory test for the Ishihara test. “Richmond HRR test” is used to classify the severity into “mild, medium, and strong”. Other tests such as “Medmont C 100” and the “Farnsworth D15” test may be applied when the patients fail in the Ishihara test as color vision is normal. These methods are used easily and can be in a same way easily read.¹⁰⁻²⁰

One among the professions that requires a great deal of appreciation of the colors is the medical stream. Objective of our study was to assess the color blindness incidence, among the medical undergraduates at the Gandaki Medical College, Pokhara.

METHODOLOGY

We piloted a cross-sectional observational study among the medical undergraduates at the Department of Physiology, Gandaki medical college, Pokhara. The ethical clearance was obtained for the present study from Institutional Review Committee-Gandaki medical college Ref no.46/078/079). The duration of our study was conducted from August 2021-January 2022. The participant's consent was taken after explaining the details of the study to them. We included the first and second year medical students of (MBBS, BDS, Bsc Nursing, and BSc MIT and BSc MLT) who were willing to take

part in the study. Both the genders were incorporated in the study and the age of the participants was between 18-25 years. Individuals under medication and/ or suffering from glaucoma, hypertension, and intracranial and ocular pathologies were excluded from the study.

Sample size estimations is based on the previous study.⁶ The sample was calculated from the college Under graduates students, with a confidence interval of 95%, $Z=1.69$, the size was 285. We included 300 students hence to avoid any dropouts.

The number of the subjects to be considered for the study was premeditated applying statistical formula

$$N = Z^2 pq / d^2 = 1.69^2 \times 0.5 \times 0.5 / 0.05^2 = 285.1$$

N = Minimum sample size

Z = Standard deviation (1.69 corresponds to 95% confidence interval)

P = Estimated disease prevalence $q = 1 - p$

d = difference between two sub samples”

Data collection Method: “Ishihara Chart” (“Ishihara Type Tests for Color Blindness-38 plates (2002) Eye Care-Ludhiana, India”) was used in our study. The numbers 1-17 on the plates were asked to be read by the subjects in a time frame of 3 sec. For those who were positive in the first attempt were given a repeated test for confirmation.

The individuals with the defect cannot read the numbers from the plates 12-13. The plates 14-15 will be identified by only “red-green color blinds”. The plates 16-17 are used to distinguish between deutan and protans. In the experiment, if 13 or more plates were read correctly, the vision was regarded as normal otherwise the individual will be recorded as Color vision deficiency person.

Data analysis was done using the Microsoft Excel and IBM.SPSS version 21.0. For the comparison of the various parameters “chi square” test was used.

RESULTS

We observed that among the 300 participants, the male students were 178, while female were 122. The gender distribution of the study subject is shown in Figure 1.

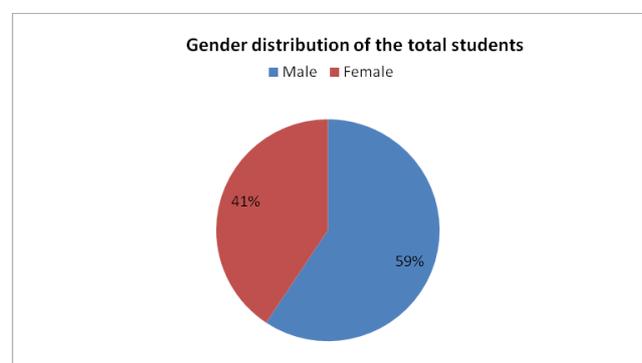


Figure 1: Gender distribution of the total students

Of the 300 students we observed that all were male participants who had shown the color blindness. The number of the subjects with the color blindness in our study

was 6. This constituted 3.3% of the total male participants, while the percentage was 2 from the total number of the medical students as shown in Table 1

Table 1: Comparison of color blindness among the genders.

| Genders | N | Color blind | % |
|---------|-----|-------------|------|
| Male | 178 | 6 | 3.3% |
| Female | 122 | 0 | 0 |
| Total | 300 | 6 | 2% |

We observed that of the 6 male subjects diagnosed as color blind 4 had Deuteranomaly, 1 had Deuteranopia, and 1 had Protanomalopia. The distribution of the various types of the color blindness was Deuteranomaly- 67%, Deuteranopia-16%, and Protanomalopia- 16%. We observed a significant difference for the various types of the color blindness. (Table2)

Table 2: Comparison of the different types of color blindness.

| Type | N | % | P |
|----------------|---|------|-------|
| Deuteranomaly | 4 | 67 % | 0.059 |
| Deuteranopia | 1 | 16 % | |
| Protanomalopia | 1 | 16 % | |

DISCUSSION

One of the most common inherited eye diseases that usually go unnoticed is color vision deficiency. This inherited disease differs between genders, and also races.¹⁰⁻¹⁵ The condition where there is inability to distinguish the colors of the spectrum clearly is color blindness. Healthy human has the color vision that is a made of the combinations of blue, green, red lights. In the patients with the color defects the inability to differentiate the colors is genetic and is permanent. Among the three colors the most common are the defects of the Deutan and the Protan among the world populations. This defect has X-linked recessive mode of inheritance. Hence this defect is most commonly seen in men. The women however are the carriers and rarely the color defect is also seen in women. However the color blindness may also be seen to be acquired in other illnesses like "chronic illnesses that damage the retina, optic nerve, and the brain as diabetes mellitus, sickle cell anemia, and retinitis pigmentosa". They may also arise in the adverse effects of the medications like "sildenafil, digoxin, ethambutol, furosemide, metronidazole, and few antimalarials".

When the distribution of the color blindness is observed it is noted that among the Asians to be nearly 5%, while it was less than 0.5% among women, while in American blacks, China and Japan it was less than 4%, while it was nearly 5% among Korea and the Singapore populations. The greatest incidence was seen among the Tehran, America, European whites with nearly 10%.¹⁶⁻²¹ Though the disease is not life threatening, the disease may limit the individual from fully enjoying the life and may even cause the patient to refrain from the jobs like military and loco-pilots or even the

medical profession. The previous studies have stated the incidence lower than 3% in the general population of the nepal.⁷ Hence we aim to analyze the prevalence of this defect among the medical UG students of Gandaki medical college, Pokhara.

We observed that all the subjects who were color blind in our study were men. Our observations are similar to the study of Niraula et al. Shrestha et al and Jha et al.^{7,8,22} Greater prevalence was seen in the studies of Masood et al. Kharel et al. and Pramanik et al.^{2,4,5} Similar to our study where no girls were noted to have the deficiency, the studies of Shrestha RK et al. and Niroula DR et al. concluded similar results.^{7,8} Nevertheless, the observations of our study are higher than the levels of the prevalence of the various studies that were conducted in the regions of Congo, Uganda, while our study observations are similar to the regions of China, Colombia, India, and Libya where nearly 2% of their subjects had color blindness.²³⁻²⁷

The prevalence of the color vision deficiency in our study was 2%. The defects in the deutan and the protan are the most common types of the color deficiencies. The Ishihara's chart that was named after the Japanese professor is used for the diagnosis of the color vision deficiencies. Majority exhibited Deuteranomaly of the subjects with the color vision deficiency. Pramanik T et al. in a similar study among the Nepalese students found a similar distribution for the types of the vision deficiencies.⁵

In the study of Dhingra et al. they have described the problems doctors had to face if they are color blind.²⁸ The students who have the color blindness and get admitted in the medical schools have a great difficulty in differentiating the various colors of the tissues that is obvious from the start of their career. They commit more mistakes than their colleagues. The errors committed by them are very evident while learning some particular subjects in some of the medical specialities. The students who don't have any color blindness perform better than those who have this genetic defect. This performance is not very evident among the patients with mild color defect compared to the severe forms.

It has been stated that the most common difficulties felt due to the color blindness among the medical doctors include: misapprehension of the prevalent body color variations of erythema of skin, rashes, pallor, jaundice and cyanosis. Likewise, in the study Campbell et al. they concluded that the doctors with color blindness were unable to clearly identify the clinical pictures than the doctors who had normal vision.²⁹

In our study it was known that the students with color blindness were not aware of their defect. Similar reports were given in the previous studies where the subjects were also not aware of their problems. It is also well noted that the problem is often neglected if not over looked by the physicians. Hence it is suggested that the medical students be held for the screening even before they join the course. This screening is practiced in the countries like America and India. This will help them be conscious of their color



blindness position and comprehend their limits, so that they can warrant a safe practice.

While the tool used was a screening tool for deutan and protan defects with great sensitivity and specificity it is suggested that an additional confirmatory tool "Richmond HRR test" be used to identify "Tritan" defects. Distinguishing deutan from protan defects is also commended for the affected members using "Medmont C100 Test", and "Farnsworth–Munsell 100 Hue Test" to assess severity and diverse patterns.

Color vision is most essential in both civil and professional terms.³⁰ The schools and the educational institutes should practice the screening for the color deficiencies among the students. However this method is followed only in few European countries. The screening of the students prior to the enrollment in the medical courses is of great value as the previous studies have reinforced a poor recognition of the patients' signs among the color blind medical students. Since these professions require the identification of the color screening for these conditions is suggested.¹²⁻¹⁵

CONCLUSION

Identification of the defect is the first step to rectifying the defect. We can conclude that color vision deficiency was highly gender specific with prevalence chiefly among the men. The early detection of this defect will enable the student to be aware of the condition and help in making better choice regarding the selection of the profession.

RECOMMENDATIONS

We suggest a larger study be conducted among the children across various schools in Nepal so that the color defects are identified at an early stage. This will help the children and their guardians be aware of their condition and plan their profession accordingly.

LIMITATIONS OF THE STUDY

There were however few limitations in our study. We included only the students of the medical college hence the observations of our study can't be generalized to the public. The Ishihara's chart is used only for the detection of the color blindness; hence for the final diagnosis Anamaloscope is used.

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CONFLICT OF INTEREST

None

FINANCIAL DISCLOSURE

None

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