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ORIGINAL ARTICLE

CONGENITAL COLOUR VISION DEFICIENCY (CVD) AND ITS RELATION WITH ABO BLOOD GROUP AMONG MALE SCHOOL STUDENTS OF DUWAKOT, BHAKTAPUR

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ABSTRACT

Introduction: *Normal person can interpret colour in all three of its attributes; Hue, intensity, and saturation. Human beings can perceive three primary colours, that is, red, green, and blue. Any defect in appreciation of colours is known as colour vision deficiency (CVD). Blood groups are genetically inherited as well. The study was undertaken to find out the prevalence of CVD among school students in Duwakot and to find out its relation with ABO blood groups, as these two entities are both inherited genetically.*

Materials and Methods: *Permission was taken from the Institutional Review Committee of KMC to conduct this study. The study was carried out among the 8th, 9th and 10th grade school students of Duwakot, Bhaktapur. Ishihara test plates for colour vision and agglutination method for ABO blood grouping were used to get the prevalence of CVD and to get the percentage of students belonging to ABO blood group among those having Colour Vision Deficiency.*

Results: *It was found out that, out of 150 students, 133 (88.67%) were normal. 17 students (11.33%) were having CVD. No one was found complete colour blind. Prevalence of blood group among study population was O (38%) which was followed by B (31.61%), A (23.33%) and AB (8.66%),respectively. All the defects were of red-green type, hence were transmissible genetically. Distribution of blood group in CVD subjects shows 9 (52.94%) numbers belonging to blood group B, 4 (23.53%) belonging to blood group O, 3 (17.64%) belonging to blood group AB, and 1 (5.8%) belonging to blood group A.*

Conclusion: *The study helps the subjects to be aware of their condition early in their professional life so that they can choose correct profession. It also tried to find out the percentage distribution into ABO blood groups. A larger population should be included to get more accurate results.*

Keywords: *ABO Blood Groups, Congenital Colour Vision Deficiency, Ishihara Chart, School Students*

INTRODUCTION

Colour is the wavelength of light transmitted to the eye and is interpreted as well as perceived by the visual cortex. Colour vision perception and interpretation is vital interaction between the wavelength of light, independent of its intensity, and photo transduction across the ophthalmic pathway, from the retinal cones to the visual cortex of the brain. Human beings have capacity to perceive the colour in all three of its attributes, that is, hue, intensity, and saturation.[1]

The females in generation I pass the genetic material to all her sons but not to daughters. If the offspring in generation II marry normal person, the colour deficient sons will produce all normal male and female offspring (III - 1, 2, and 3); the normal daughters without CVD will produce normal vision abnormalities, in comparison to recessive autosomal disorders. This X -linked recessive character occurs principally in males. The reason is that the only sources of the mutant allele in the population are in heterozygous mothers who are "carriers" and do not present the disorder. They pass the allele to one half of their sons, who develop the abnormalities because they are hemizygous. Heterozygous mothers also pass the allele to one half of their female offspring, who become carriers but do not develop the abnormalities.[2,3] CVD represents a group of retinal disorders that affect the perception of colours, resulting from either an absent or functional loss of one or more colour pigments or a reduced response or spectral sensitivity of the cone receptors to particular wavelengths.[4, 5] Karl Landsteiner first stated that there is variation between bloods of different individuals which lead in inventing the modern system of classification of ABO blood groups. In 1930, he received the Nobel Prize for Physiology or

Medicine for this invention. This was a greatest finding as it made the foundation for safe blood transfusion. Different research showed that various blood groups are genetically inherited as well. And certain diseases show more prevalence in individuals belonging to a specific blood group, for example, carcinoma of stomach is more common in blood group A individuals and duodenal ulcer in blood group O individuals. Increased in occurrence of myocardial infarction and diabetes mellitus in blood group A.[6] Furthermore, red–green and blue-cone monochromatic Colour Vision Deficiency are congenital, with red–green CVD being more prevalent affecting 8.0% of males and less than 0.5% of females worldwide.[7]

Abnormalities in colour vision are mostly congenital defects. Hereditary determined transmitted as sex linked by two pair of genes in the non-homologous part of X-chromosome; acquired type due to ophthalmic and Central Nervous System diseases are usually rare. Protanopes are insensitive to red light, deuteranopes are not insensitive to green but can match all colours with a red and blue. Tritanopes have some insensitivity to blue light.[8] Many studies on disordersin mental health, various congenital disorders and muscular dystrophy and its association with blood groups have also been identified. Like ABO blood groups andabnormalities in colour vision mostly congenital ones are also determined by heredity.[9]

There are four main ABO blood groups that are recognized by proteins on red blood cells. These proteins, called antigens, are markers that help the body identify our blood. Blood type is inherited from one's parents.

The four main blood types are:

Type A – Has the A antigen on the surface of red blood cells

Type B – Has the B antigen on the surface of red blood cells

Type AB – Has both Type A and Type B antigen on the surface of red blood cells

Type O – Has neither Type A or B antigen on the surface of red blood cells

In addition, some people have a marker called Rh factor on their blood cells. These people are considered as Rh positive. Individuals that do not have this marker are considered Rh negative.

MATERIALS AND METHODS

The study was a cross-sectional study carried out from February 2023 to December 2023, among school students of Duwakot, Bhaktapur after obtaining approval from the Institutional Review Committee (IRC) of Kathmandu Medical College and Teaching Hospital. The subjects were aged between 13 and 16 years and all were males. Females were not included in the study. Females develop colour blindness only in the condition when both the X chromosomes are defective, which is rare. So, colour blindness mainly affects males, with a mean age of 14.46 years (SD±1.52). Total 150 students were enrolled for the study after taking consent from school authorities and parents. Students who had refractive errors were excluded from the study. Colour vision was tested using Ishihara polychromatic plates containing printed figures or numbers made up of multiple colour spots on a background of spots of recommendedshape and size.[10] The figure or number can becorrectly read by a normal person, whereas a person with Colour Vision Deficiency will read a different figure or number or he will not be able to read it, all together. Each eye was tested individually and separately from a distance of 75 cm from the objectthe test chart as per international protocol. The plates were held at right angle to the eye. The illumination of the room was maintained so that the subject can read the chart comfortably. Each plate was shown for a period of three seconds. Blood grouping of each participant was done by slide method. Commercially prepared antisera A, B and Rh, each was taken and placed on left and right side of a glass slide and for Rh on a separate glass slide as per the protocol. After two minutes both the glass slides were examined for clumping with a naked eye and with a microscope. The results obtained were carefully noted down for the particular subject. Sample size estimation was based on the previous study.[11] The sample was calculated with a confidence interval of 95%, Z= 1.96 and prevalence=9.77% in males.

The number of the subjects to be considered for the study was premeditated applying statistical formula $N = Z^2pq/d^2 = 136$. As minimum sample size calculated was 136, we enrolled 150 students from grade 8, 9 & 10 from different schools of Duwakot. Simple random sampling was done for the selection of the study subjects.

Statistical analysis: The data were entered in Excel and analysed by SPSS version 21. Frequencies and percentage were used for different variables. The p value of less than 0.05 was considered as statistically significant.

RESULTS

It was found out that, out of 150 students, 133 (88.67%) were normal. 17 students (11.33 %) were having CVD [Table 1]. No one was found to be colour blind. Prevalence of blood group among study population was O (38%) which is followed by B (31.61%), A (23.33%) and AB (8.66%), respectively (Table 1).Prevalence of blood group among study population was O (38%) which was followed by B

(31.61%), A (23.33%) and AB (8.66%) respectively (Table 2).All the defects were of red-green type, hence were transmissible genetically. Distribution of blood group in CVD subjects shows 9 (52.94 %) numbers belonging to blood group B, 4 (23.53%) belonging to blood group O, 3 (17.64 %) belonging to blood group AB, and 1 (5.8%) belonging to blood group A. There was no colour blind student (Table 3).

Table 1: Distribution of type of Colour Vision Deficiency (CVD) in study population (N=150).

Types	Numbers	Percentage
Normal	133	88.67 %
CVD	17	11.33 %
Colour Blindness	0	0 %
Total	150	100 %

Table 2: Distribution of ABO blood groups in the study population (N=150).

Blood Group	Total Population	Total Frequency (%)
A	35	23.33
B	45	31.61
AB	13	08.66
O	57	38.00
Total	150	100

Table 3: Blood group wise distribution of Colour Vision Deficiency (CVD) of the study population (N=150).

Blood Group	CVD (N)	CVD %	Colour Blindness(N)	Colour Blindness %
A	1	5.8 %	0	0 %
B	9	52.94 %	0	0 %
AB	3	17.64 %	0	0 %
O	4	23.53 %	0	0 %

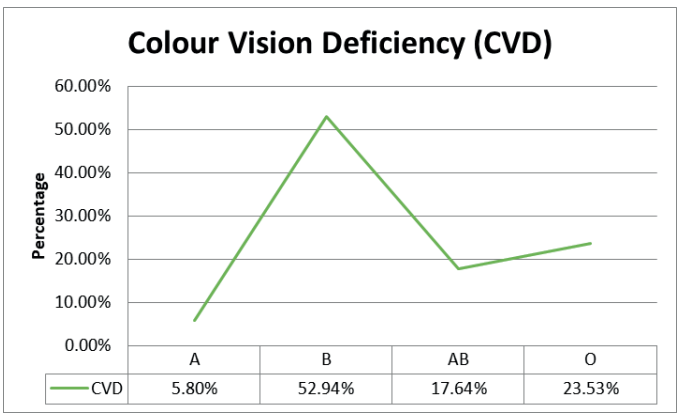

Figure 1:Blood group wise distribution of Colour Vision Deficiency (CVD) of the study population (N=17).

DISCUSSION

The present study showed that the prevalence of CVD was highest in the blood group B (52.94 %). The prevalence of CVD in our study was 11.33%. Similar to our study done in U.S.A., the prevalence was 12.8% among medical students[12] and 7.8% in dental students.[13] About 7% male and 0.4% female population was said to have CVD in general American population.[14]

A previous study in a medical college in coastal Odisha reported a prevalence of 8.91% in males and 0% in females.[15] Ebrahim[16] reported the percentage distribution of CVD among different blood groups in Kerala as 32 in group A, 27 in group B, 31 in group O, and 10 in group AB. CVD prevalence varies in different geographical area from race to race.[17, 18]

Variations in the prevalence of congenital CVD have been reported among people of different races and geographical areas.[19] Consequently, to uncover the overriding factors that influence the variability in prevalence and to synthesize the salient theme that dominates prevalence studies both regionally and globally, the current study analyzed the distribution of CVD by race/nationality. The distribution of CVD by nationality revealed that Asians (50.4%), Arabians (20.0%), and UAE Nationals (18.0%) had a higher prevalence of CVD compared to other nationals (including Africans and EuroCaucasians) (12.0%) and GCC Nationals (0.8%).[20]

CONCLUSIONS

Colour Vision Deficiencyhasremarkable prevalence among young students in Nepal, with its distribution and correlation with ABO blood groups. Early screening enables and ensures ascertain their CVD status and can prevent future consequences. Furthermore, identifying subjects based on their ABO blood groups can play more effective role.

No prior study was done in Nepal about the CVD and its relation with ABO blood group. Further research involving a larger population is necessary.

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CONFLICT OF INTEREST: No

REFERENCES

1. Neitz M, Neitz J. 2000. Molecular genetics of color vision and color vision defects. Arch Ophthalmol. 118(5):691–700. doi:10.1001/archopht.118.5.691

2. Barret KE, Barman SM, Boitano S, Barma S. Vision. In: Ganong's Review of Medical Physiology. 26th ed. New Delhi: Tata McGraw Hill Education Private Limited; 2019. p. 185-204

3. Vaz M, Kurpad A, Raj T. Guyton and Hall's Text book of

Physiology. South Asia edition. 2nd ed. Netherlands: Elsevier; 2016. p. 779-86.

4. Mackey DA. 2022. What colour are your eyes? Teaching the genetics of eye colour & colour vision. Edridge green lecture RCOphth annual congress Glasgow May 2019. Eye. 36(4):704–715. doi:10.1038/s41433-021-01749-x.

5. El Moussawi Z, Boueiri M, Al-Haddad C. 2021. Gene therapy in color vision deficiency: a review. IntOphthalmol. 41:1917–1927. doi:10.1007/s10792-021-01717-0.

6. Adhiya AN, Jagdale BV, Waykole SM, Zarekar SN. Medicolegal aspects of colour blindness and correlation of the same to blood groups. Indian J Forensic Med Pathol 2009;2:45-7.

7. Delpero WT, O'Neill H, Casson E, et al. 2005. Aviation-relevent epidemiology of color vision deficiency. Aviat Space Environ Med. 76(2):127–133.

8. Dalton J. Extraordinary facts relating to the vision of colors: with observations. Memoirs of the Literary and Philosophical Society of Manchester 1798; 5:28–45.

9. Nathans J, Piantanida T. P, Eddy R. L, Shows T. B, Hogness D. S. Molecular Denetics of Inherited Variation in Human Color Vision. Science 1986; 232:203–10.

10. Ishihra, S. (1959) Test for colour blindness, KanicharaShuppan Co Ltd., Tokyo-Kyote, Japan.

11. Shrestha P, Pradhan PMS. Congenital Colour Vision Deficiency among Patients Attending Outpatient Department of Ophthalmology in a Tertiary Care Centre: A Descriptive Cross-sectional Study. JNMA J Nepal Med Assoc. 2022 Mar 11;60(247):278-281. doi: 10.31729/jnma.7319. PMID: 35633257; PMCID: PMC9226731.

12. Logan JS. The disability in so-called red green blindness: An account based on many years of self-observation. Ulster Med J 1977;46:41-5.

13. Davidson SP, Mysilinki NR. Shade selection by colour vision defective dental personnel. J Prosthet Dent 1990:63:97-101,

14. Colour Blindness: More Prevalent Among Males. Available from: https://www.hhmi.org/sences/b130.html [Last accessed on 2004 Nov 16].

15. Kar SS, Agrawala M. A study on color vision deficiency among medical students of Odisha. J Evid Based Med Healthc. 2018;5:806-8.

16. Ebrahim NK, Shaker IA, Kadhir A. Prevalence of color vision deficiency (CVD) and ABO blood groups in Kannur district of Kerala, India. Int J Bioassays. 2016;5:4760-3.

17. Niroula DR, Saha CG. The Incidence of Color Blindness among some School children of Pokhara, Western Nepal. Nepal Med Coll J. 2010;12(1):48-50.PMID: 20677611.

18. Poole C. J. M, Hill D. J, Christie J. L, Birch J. Defective colour vision and interpretation of histopathology slides: cross sectional study. Br Med J 1997; 315:1279– 81.

19. Mitiku RG, Tolera BS, Tolesa ZG. 2020. Prevalence and allele frequency of congenital colour vision deficiency (CCVD) among students at Hawassa University, Ethiopia. Journal of the Egyptian Public Health Association. 95:1–6. doi:10.1186/s42506-020-00037-y.

20. Fakorede ST, Akpan LG, Adekoya KO, et al. 2022. Prevalence and population genetic data of colour vision deficiency among students from selected tertiary institutions in Lagos state, Nigeria. Egypt J Med Hum Genet. 23(1):1–8. doi:10.1186/s43042-022-00287-9.