Original Research Article
Journal of Kathmandu Medical College, Vol. 12, No. 4, Issue 46, Oct.-Dec., 2023

Prevalence and patterns of colour vision defect among school students in Bhaktapur municipality, Nepal

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Abstract

Background: Colour vision deficiency is the commonest disorder of the eye that can be congenital or acquired. The colour vision disorders are usually undiagnosed due to unawareness of the disease, lack of screening, and adaptation by patients to environment to some extent.

Objectives: To find out the prevalence and pattern of colour vision defect among school students of ages nine years to 18 years in Bhaktapur municipality, Nepal.

Methods: This community-based, analytical, cross-sectional study done was among 1140 school students of Bhaktapur municipality of ages nine years to 18 years. Data collection was done from 2021 October to 2021 December utilising random sampling. The ethical clearance was obtained from Institutional Review Committee of Tilganga Institute of Ophthalmology. Assent and informed consent were obtained before data collection. Descriptive statistics such as mean, standard deviation, frequency, and percent were calculated.

Results: In total 596 (52.2%) were male students and 544 (47.7%) were female with the mean age of distribution 13.7±3.2 years. The prevalence of colour vision defect obtained was 3.6% in 41 cases, among 29 (4.8%) male and 12 (2.2%) female. Of the total colour vision defects, 19 (46.3%) were deuteroanomaly, 12 (29.2%) deuteroanopia, and 10 (24.4%) were protanomaly.

Conclusion: This study concludes that the prevalence of colour vision defect is significant. Early detection at school level helps to meet up with one's potential build up in respective field and in counselling to step down from choosing certain profession in future.

Key words: Colour blindness; School children; Screening.

Access this article online

Website: www.jkmc.com.np

DOI: https://doi.org/10.3126/jkmc.v12i4.70909

HOW TO CITE
Joshi K, Poudel M, Shrestha N. Prevalence and patterns of colour vision defect among school students in Bhaktapur municipality, Nepal. J Kathmandu Med Coll. 2023;12(4):217-20.

Submitted: Dec 21, 2023
Accepted: Feb 19, 2024
Published: Feb 27, 2024

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ISSN: 2019-1785 (Print), 2091-1793 (Online)

INTRODUCTION

Colour vision, an important attribute of visual perception,[1] results from stimulation of cone cells. Colour blindness is a common X-linked genetic disorder.[2] The incidence varies in different races, geographical regions of the world, and different ethnicity.[3] It may be congenital or acquired.[4] Congenital is X-linked non-pathologic, non-progressive, and incurable.[5] Acquired colour vision defect (CVD) develops secondary to ocular and systemic conditions or as side effect of certain medications, toxic effects of chemicals, trauma, and ageing,[6] and is usually asymmetric or unilateral, and transient.

Colour vision defect people may have increased reaction time leading to learning disability, decreased efficiency unfit for certain jobs that require proper perception of colours, and may cause accident.[2] Most of colour blinds remain undetected in general population due to absence of proper screening.[7] The prevalence of CVD has

been studied in various population groups around the world and it ranges from 2-10% for boys and less than 0.1-3% for girls.[8,9] Ishihara pseudoisochromatic test is quick, easy, and excellent screening tool to detect those with CVD.[10]

This study aimed to assess the prevalence and patterns of congenital colour vision defect among school going children aged 9-18 years and create awareness regarding choices in their career.

METHODOLOGY

This is community-based analytical cross-sectional study conducted among school children of Bhaktapur, Nepal from the month of October - December 2021. The ethical clearance was obtained from Institutional review committee of Tilganga Institute of Ophthalmology (Ref. 21/2021). Assuming the prevalence of CVD in children as 2.02%[13] with 95% confidence and 45% relative precision[11] of the prevalence, the minimum sample size for the study was 959. Assuming 20% non-response, the total sample size was 1150. A total of 1140 students who met the inclusion criteria were included in the study, making 94% response rate. The total numbers of community-based upper primary and secondary schools in Bhaktapur municipality at the time of data collection was 13. Among the 13 schools in Bhaktapur municipality two schools are selected randomly with number of students 525 in one school and 615 in another school. Screening of upper primary and secondary school students from grade three to grade plus-two level of ages 9-18 years were included in the study. Patients with ocular and intracranial pathologies, hypertension, media opacities, retinal/ optic nerve pathologies, under medications, and history of intraocular surgery (e.g., vitreoretinal procedures, glaucoma surgeries), were excluded from the study.

This study adheres to the tenets of Declaration of Helsinki. All students who consented to the study or whose consent was given by guardian or teacher/ principal were included. All the data of the study participants were kept confidential. Students were called grade wise and demographic factors as age and sex were noted. Basic ocular examination of both eyes with visual acuity assessment with and without refraction was noted. The colour vision assessment was done in well lighted room. Variables that would affect the study: such as the source of light, the room for the study, and time the test was held were kept constant for all the participants. Data were analysed to assess the colour vision defects and the type of colour blindness.

The Ishihara chart 38 plate was held at a distance of 75 centimetres in well-lighted room and tilted at right angle in the line of vision performed by the well-trained optometry team. Each plate was allowed to read for not more than five seconds and results were noted. The types of colour vision deficiency were differentiated with the help of key provided with the chart. The tests were performed as recommended by Ishihara. According to the test guide manual of the Ishihara test, if four plates or more were not identified correctly, the participant was considered as having colour vision defect.[12-14] Those found to have colour vision defect and respective guardians were informed about their condition and how it may affect their future choice of occupation or profession. All the data were entered and cleaned in Microsoft Excel sheet. Statistical analysis was done in IBM SPSS Statistics for Windows, version 20 (IBM Corp., Armonk, N.Y., USA). Descriptive statistics such as mean, standard deviation (SD), frequency, percent with 95% confidence interval (CI) were determined. For association of categorical data, Chi-square test was used and p-value <0.05 was considered as statistically significant.

RESULTS

Among 1140 students, 596 (52.3%) were male students and 544 (47.7%) were female students with the mean age of distribution 13.8±3.2 years. The total prevalence of colour vision defect was 3.6% (41/1140, Table 1). Similarly, the prevalence of colour vision defect was 4.9% (29/596) in male while 2.2% (12/544) in female (Figure 1). Gender was statistically significant with colour vision defects, having males exhibiting a higher prevalence (p = 0.016). Out of the 41 cases, 19 cases were deuteroanomaly, 12 deuteroanopia, and 10 protanomaly (Figure 2).

Table 1: Age distribution of colour vision defect children

Age category (years)	Total number	Colour vision defect, n (%)	Confidence interval
9-10	240	9 (3.8)	1.35-6.15
11-12	246	9 (3.7)	1.33-6.01
13-14	122	4 (3.3)	0.12-6.44
15-16	172	6 (3.5)	0.75-6.23
17-18	360	13 (3.6)	1.68-5.54
Total	**1140**	**41 (3.6)**	**2.52-4.68**

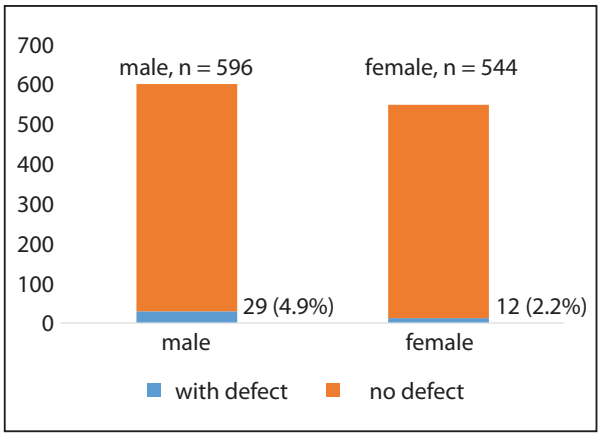

Figure 1: Gender distribution of colour vision defect children

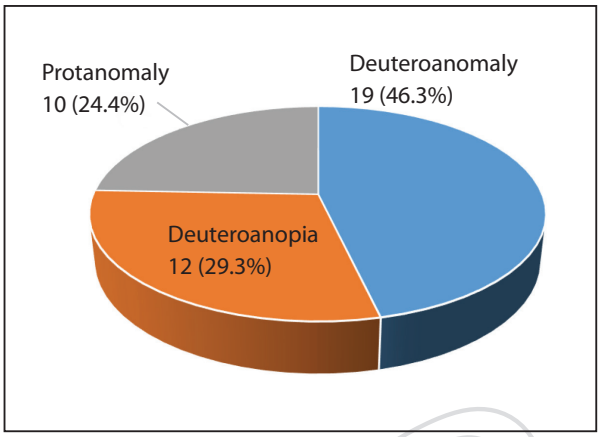

Figure 2: Type of colour vision defect children (n=41)

DISCUSSION

Colour blindness is a non-fatal disorder, therefore, colour blind people usually remain unaware of the defect since their vision is otherwise normal.[15] Normal colour vision is important for one's daily life work such as to recognise the traffic signals during crossing roads or to build career in several professions like military, pilot, driver, chemist, etc.[16] Some people are unaware of the disease as they simply adapt to the environment to a certain extent and thus remain undetected.[17]

In the present study, the prevalence of colour vision defect was seen in 3.6% (41/1140), males 4.9% (29/596), and 2.2% (12/544) females. Of the 41 cases, 19 cases were deuteroanomaly, 12 deuteroanopia, and 10 protanomaly. The colour vision defect percentage looks similar to the other studies. A similar study conducted by Kharel et al., in school children of Bhaktapur revealed defect among 5.1% boys and 2.5% girls.[18] Another study done by Niroula and Saha among school children of Pokhara from 10-19 years reported 3.8% of school boys had colour vision defect, nine were denuteroanopia, six were deuteroanomaly, and three were protanomaly.[19] Study done by Pandit and Dhakal in assessment of colour vision among 300 health science students of age group 18-25 years reported colour vision defect in seven male participants, 4.6% of total male participants with one protanomaly, two deuteranomaly, and four deuteranopia.[20] Woldeamanuel and Geta study in colour vision deficiency in southern Ethiopia showed defect in 4.1%, which was 3.6% in boys and 0.6% in girls, with 42.9% protan and 57.1% deutan.[4]

In contrary, Shrestha and Shrestha conducted study in four different schools of Kathmandu reported colour vision defect in 2.6% males.[1] Similarly, study done by Bhusal et al. among medical students showed defect in 2.27%, four red-green defect and one total colour blindness.[10] Moudgil et al. reported colour blindness in 1.89%, comprising of 55 males and six females.[2] Pattern and prevalence of colour vision disorders amongst secondary school students in Nigeria, as reported by Aprioku and Awoyesuku revealed colour vision disorders in 2.8%, comprising 2.1% males and 0.7% females, deutan defects 1.8%, protan defects 0.4%, and tritan defects 0.2%.[21] Study done by Oduntan et al. in Nigeria showed the prevalence of defect in 2.5% with males comprising 4.8% and females 0.7%. Among them 0.7% were protan deficiency, 1.6% were deutan deficiency, and 0.1% were unclassified.[22] A study done in prevalence of colour vision deficiency and its correlation with amblyopia and refractive errors by Zhale et al., in 36 primary schools reported the defect in 2.2%, boys 3.5% and girls 1.0%.[23] However, the increased deutan defects correspond to various studies conducted by Aprioku and Awoyesuku[21] and Oduntan et al.,[22] whereas increased protan defects were seen in study by Moudgil et al.[2]

The variation in prevalence and type of defect may be explained due to ethnical diversity in different population and geographical areas or practice of consanguineous marriage in some parts of world. The increased defect in male victims was seen in all mentioned studies. The limitation of the present study is small sample size and that the children were examined for red and green defects only since the chart is not specially designed to detect blue and yellow defects.

CONCLUSION

Most colour vision defect individuals have difficulties in dealing with colours in everyday life and at work. The cases are under-reported due to a lack of its awareness

and adaptation of victims to some extent. This study may help in timely diagnosis of colour vision defect, minimise the future disappointment, and help in assisting in counselling for alternative or suitable career choices. This can be done by making the screening programs of colour vision test compulsory at schools and community levels.

ACKNOWLEDGEMENT

The author is thankful to the whole ophthalmology team of Tilganga eye hospital and Khwopa, school teachers, students, and their guardians for the participation in the study.

Conflict of interest: None.
Source(s) of support: None.

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