Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 05, 2024

Original Research Article

Screening of Colour Vision Defects and its Impact on Quality of Life in Patients Attending Eye OPD at Tertiary Care Hospital, Bhopal

Dr. Harpal Singh[1], Dr. Satendra Singh[2], Dr. Kanchan Singh[3], Dr. Ritu Gupta[4], Dr. Pragyl Chaturvedi[5], Dr. Shubham Gupta[6]

[1]Professor & HOD, Department of Ophthalmology, Peoples College of Medical Sciences and Research, Centre Bhopal, Madhya Pradesh, India.
[2]Associate Professor, Department of Ophthalmology, Peoples College of Medical Sciences and Research, Centre Bhopal, Madhya Pradesh, India.
[3]Assistant Professor, Department of Ophthalmology, Peoples College of Medical Sciences and Research, Centre Bhopal, Madhya Pradesh, India.
[4]Assistant Professor, Department of Ophthalmology, Peoples College of Medical Sciences and Research, Centre Bhopal, Madhya Pradesh, India.
[5]Second Year Junior Resident, Peoples College of Medical Sciences and Research, Centre Bhopal, Madhya Pradesh, India.
[6]Second Year Junior Resident, Peoples College of Medical Sciences and Research, Centre Bhopal, Madhya Pradesh, India.

Corresponding Author
Dr. Ritu Gupta, Assistant Professor, Department of Ophthalmology, Peoples College of Medical Sciences and Research, Centre Bhopal, Madhya Pradesh, India.

Received: 05-03-2024 / Revised: 11-03-2024 / Accepted: 18-04-2024

ABSTRACT

Purpose
To determine the proportion of colour vision defects according to demographic profile and its impact on quality of life among patients attending eye OPD at a tertiary care hospital.

Method
A cross-sectional observational study was conducted during the time period from November 2019 to April 2021 on 1113 patients of above 7 years age attending eye OPD at a tertiary care hospital. Detailed ocular examination including Colour Vision testing with Pseudoisochromatic Ishihara plates was done; a validated questionnaire to assess the quality of life will be given to all the participants. All the data obtained were analyzed using SPSS version 20.

Results
Out of 1113 study subjects, congenital colour vision defect was found in 12 (1.1%) while acquired colour vision defect was found in 26 (2.3%). Hence the cumulative colour vision defect was found in 38 i.e. 3.4% cases ,Mean age was found to be 27.9 ± 17.9 years, female to male ratio was 0.85:1.Quality of life was affected in 36 cases, of them, emotional component was affected the most (94.7%), followed by activities of daily living (81.6%) and work related component (78.9%). Among the congenitally color vision defective individuals all three components of QOL were equally and significantly affected i.e. 91.7%.

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 05, 2024

Conclusion
to conclude our study, we found that a significant proportion of study population has colour vision defects which are widely distributed among the various demographic groups of the community but the general population is rarely screened for them and thus it remains an under-diagnosed ophthalmic disorder. Congenital colour vision defect is more common in the male population Presence of congenital CVD affects career options and literacy level of the affected individuals. Majority of the affected individuals suffer from deterioration in their quality of life in various aspects like day to day activities, emotional status and work related difficulties early detection, proper counseling and rehabilitation of individuals suffering from this ocular morbidity is the need of hour.
Key Words- Colour vision defect, Screening, Congenital, Acquired.

INTRODUCTION

"Colour vision deficiency is an abnormal condition characterized by the inability to clearly distinguish between different colours of the spectrum under normal lighting conditions."[1] Human colour vision is normally trichromatic, that is, a mixture of red, green and blue colours. Colour vision defects are divided into congenital and acquired forms. Red-green defects are inherited as X-linked recessive disorder, which explain its predominance among the males. Blue colour gene is located on chromosome 7 and has an autosomal dominant inheritance. The commonest form of deficient colour vision is red-green deficiency (Protan-Deutan Defect) which is mostly inherited; total colour blindness also known as Monochromacy is very rare. The distribution of colour vision deficiency varies among different demographic groups and geographical variations are also seen. The prevalence of colour vision deficiency is reported to be about 8% in males and 0.4% in females globally[1]. Prevalence is higher in Arab countries which ranges between 8 to 10% in males. Among Asian males it is approximately 4.9% compared to 0.6% in females. In India the prevalence is about 3.69% in males and 1.04% in females[2]. A recent Muslim population based study in India reported a prevalence of 8.13% in males and 1.69% in females[3]. Since colour vision deficiency is mostly X-linked recessive, it has a male preponderance and females are usually carriers.[4,5] according to Norwegian & Greek studies, Deutranomalous trichromatism predominates in both gender i.e. 5% in males and 0.35% in females.[1]

Acquired colour vision deficiency can be due to progressive rod & cone dystrophies, retinitis pigmentosa, optic neuritis, CSR, ARMD, glaucoma, brain or retinal damage caused by head injury or ocular trauma, systemic and metabolic causes eg; diabetes, hepatic encephalopathy, vitamin A deficiency etc which leads to degenerative changes in retinal cones, exposure to UV-rays, solvent induced retinopathy and sometimes it is drug induced (chloroquine, ethambutol, phosphodiesterase 5 inhibitors like sildenafil, thioridazine, digoxin etc).[1,6]

The Ishihara Pseudoisochromatic Plate test which consists of a series of pictures of coloured spots with a number embeded in it. Inability to identity a number suggests some defect of colour vision. It is the most commonly used test for screening of colour vision deficiencies. [1,7]

Those with colour vision defects are at a certain disadvantage while performing certain visual task. In children it leads to learning difficulties and impaired socialization.[8] In young

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 05, 2024

adults it leads to limitation of career choices and poor performance in particular occupations such as art, piloting, armed forces, network cabling and electronic wiring, driving, health care workers etc.[9] In medical professionals it can lead to diagnostic errors and thus may cause risk to patient safety.

Need of the Study

A significant proportion of population is affected by colour vision defects but most of them are unaware of it. Presently no specific treatment is available for this condition, but early detection is important in order to make such people aware of their ocular morbidity timely, so that they can be properly counseled and rehabilitated in order to minimize professional and psychological difficulties. Thus, we have conducted a study to document the proportion of this problem among patients attending eye OPD at tertiary care centre in Bhopal and create awareness regarding the same.

AIMS AND OBJECTIVES

Aim

To determine the proportion of colour vision defects according to demographic profile and its impact on quality of life among patients attending eye OPD at a tertiary care hospital.

Objectives

- To determine proportion of colour vision defects among various demographic groups.
- To estimate proportion of congenital and acquired cases of colour vision defects.
- To compare proportion of colour vision defects between men and women.
- To assess impact of colour vision defects on quality of life among different occupations among patients attending eye OPD.

MATERIAL & METHOD

A cross-sectional observational study was conducted in the Department of Ophthalmology, People's College Of Medical Sciences and Research Centre and associated People's Hospital, Bhanpur, Bhopal (M.P) during the time period from November 2019 to April 2021. A written informed consent was obtained from each patient before including them for study. Ethical institutional clearance was obtained for the study. Every known patient meeting the inclusion criteria & coming to eye opd were included in the study and undergone the detailed examination.

Inclusion criteria

All patients above 7 years age attending eye OPD with proper informed consent.

Exclusion criteria

- Patients under the age of 7 years.
- Patients with significant hazy ocular media.
- Patients not willing to participate.

A detailed history of patient including his/her name, age, sex, religion, address and occupation will be noted. A family history of colour vision defect or consanguineous marriage will be obtained. Details about risk factors that may lead to acquired colour vision defect such as head

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 05, 2024

injury, ocular trauma, diabetes, vitamin A deficiency, addictions, exposure to UV rays or other solvents will be asked. A detailed drug history will also be taken. A validated questionnaire to assess the quality of life will be given to participants. , after recording relevant history and taking informed consent all patients will undergo complete ocular examination involving BCVA with Snellen's chart, Slit lamp examination, Fundus examination by direct and indirect ophthalmoscope after full pupillary dilatation. Colour Vision testing with Pseudoisichromatic Ishihara Test type (38 plate edition; 2019, Published by Kanehara Trading Incorporated, Tokyo Japan)

Patient selection was done by convenient non probabilistic sampling technique. Findings were noted on the predesigned Performa. Further more as part of the study every participant with a color vision defect was given a questionnaire to assess the quality of life among those affected by this defect.

Data was compiled using MsExcel and statistical analysis was done using Statistical Package of Social Science (SPSS Version 20; Chicago Inc., USA). Data comparison was done by applying specific statistical tests to find out the statistical significance of the comparisons. Categorical data was expressed as frequency and percentage whereas numerical data was expressed as mean and standard deviation. Chi- square test was applied to study the association between categorical variables. Univariate and multivariate analysis was done to assess the risk of colour vision defect with various risk factors.
Significance level was fixed at $P \leq 0.05$.

RESULTS

The present study was conducted on 1113 patients attending the OPD, Department of ophthalmology, People's College of Medical Sciences and Research Centre, Bhopal.

Out of 1113 study subjects, (Table-1)congenital colour vision defect was found in 12 (1.1%) while acquired colour vision defect was found in 26 (2.3%). Hence the cumulative colour vision defect was found in 38 i.e. 3.4% cases. Out of the 38 color vision defective subjects, 12 (31.58%) were found to have congenital colour vision defect while 26 (68.42%) had color vision defects due to acquired causes. Among the various causes of acquired colour vision defects majority cases were of retinitis pigmentosa i.e 23%..In present study, highest proportion of colour vision defect was observed in age range of >45 years (5.3%),. Congenital colour vision defect were higher in patients belonging to age range of 15 to 30 years i.e. 6 (50%). Majority of the cases with acquired colour vision defects were found in age group of more than 45 years i.e. 12 (46.5%) cases. The mean age of CVD cases was 38.4±16.8 years; congenital CVD cases was 30.6±10.1 years and acquired CVD cases was 41.9±16.8 years. Male predominance was observed with male : female ratio of 3.7:1. The proportion of congenital CVD in males was 2.1 %.The findings of present study revealed presence of color vison defect in significantly higher proportions of patients engaged in unskilled worker (8.8%) followed by patients Shop/Business/farm/clerical workers (5.6%) and skilled workers (4.4%). All the patients with professional work were found to have normal color vision. The observed association of color vison defect with occupation was statistically significant ($p<0.05$)Out of 12 congenital CVD cases 5 (41.7%) and out of 26 acquired CVD cases 10 (38.46%) were shop/business/farm/clerical workers. In present study, color vison defect was observed in significantly higher proportions of patients educated less than senior secondary school (6.5%), The observed association of cumulative color vison defect with education status was found to be statistically significant

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 05, 2024

(p<0.05). Out of 12 CCVD cases 5(41.7%) were educated till higher secondary level and seem to have chosen their career path. Out of 75 Muslim, 4% cases had colour vision defect whereas out of 1031 Hindus, 3.4% cases had CVD. The observed association of color vision defect with religion was statistically insignificant (p>0.05)..CVD was observed in 14 (4.6%) cases in rural and 24 (3%) cases from urban areas respectively and the observed association of color vison defect with locality was found to be insignificant (p>0.05).. CVD was associated with 18.1% and 19.4% cases with hypertension and Diabetes mellitus respectively. Overall, we documented that acquired color vison defect was significantly associated with presence of comorbid conditions (p<0.05). Out of 26 acquired CVD 57% cases were associated with systemic diseases. Family history of congenital color vision defect was significantly associated with colour vision defect in our study (p<0.05) About 41.7% i.e. 5 out of 12 patients with color vision defect had history of drug (2 had history of antitubercular drug while 3 were on systemic steroids) . As compared to cases with normal color vision this observed association of color vision defect with drug history was statistically significant (p<0.05) which could be attributed mainly to acquired CVD cases. Alcohol addiction was significantly associated with acquired color vison defect in our study (p<0.05)

Quality of life was affected in 36 cases in our study(Table-2), of them, emotional component was affected the most (94.7%), followed by activities of daily living (81.6%) and work related component (78.9%). Among the congenitally color vision defective individuals all three components of QOL were equally and significantly affected i.e. 91.7%.Out of various components of daily activities, crossing traffic signals was the most commonly affects (68.4%),.Out of 4 work related components, difficulty in performing work (52.6%) and limited to work component were the most commonly affected. Majority of patients with color vison defects felt depressed (86.8%) and 65.8% cases each had feeling of let down and avoiding conversations. Among the various occupations congenital colour vision defects daily activities most in Shop/Business/farm/clerical workers i.e. 40%; work related activities in students i.e 76.9% followed by skilled workers like drivers/teachers/electrician etc i.e. 66.7% and emotional component in Shop/Business/farm/clerical workers i.e. 80% followed by skilled workers i.e. 70%.

The risk of color vison defect was observed in significantly higher proportion of cases with advanced age (OR increased with increase in age) which was mainly attributed to acquired cases(Table-3). Similarly, the risk of color vison defect in males was higher as compared to females (OR- 2.99; 95% CI 1.5-6.1, p<0.05). Presence of drug history as well as alcohol addiction were also significantly associated with risk of **acquired color vison defect** in our study (p<0.05).

Table -1 Association of Colour vision defect with various factors.

Age (in years)	**Color vision**				**Total subjects (n=1113)**	
	Total no. CVD (n =38)	**Congenital CVD (n=12)**	**Acquired CVD (n=26)**	**Normal Colour Vision (n=1075)**		
7 – 14	1 (0.9)	0 (0)	1 (0.9)	107 (99.1)	108 (9.7)	χ^2
15 – 30	13 (2.5)	6 (1.2)	7 (1.3)	512 (97.5)	525 (47.2)	7.2
30 – 45	11 (4.7)	5 (2.2)	6 (2.5)	225 (95.3)	236 (21.2)	P value
>45	13 (5.3)	1 (0.5)	12 (4.8)	231 (94.7)	244 (21.9)	0.06

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 05, 2024

Male	30 (5.1)	12 (2.1)	18 (3.0)	569 (94.9)	599 (53.8)	χ^2 16.9 P value **0.01**	
Female	8 (1.5)	0 (0)	8 (1.5)	506 (98.5)	514 (46.2)		
Professional	0 (0)	0 (0)	0 (0)	61 (100)	61 (5.5)	χ^2 16.6 P value **0.01**	
Shop/Business/farm/clerical	15 (5.6)	5 (1.9)	10 (3.8)	251 (94.4)	266 (23.9)		
Skilled worker	2 (4.4)	2 (4.4)	0 (0)	43 (95.6)	45 (4)		
Unskilled worker	7 (8.8)	1 (1.2)	6 (7.5)	73 (91.2)	80 (7.2)		
Unemployed (housewife/student/retired)	14 (2.1)	4 (0.6)	10 (1.5)	647 (97.9)	661 (59.4)		
Illiterate	4 (2.9)	1 (0.7)	3 (2.2)	135 (97.1)	139 (12.5)	χ^2 14.5 P value **0.01**	
<SSC	13 (6.5)	2 (1.0)	11 (5.5)	188 (93.5)	201 (18.1)		
SSC	10 (6.1)	2 (1.2)	8 (4.9)	153 (93.9)	163 (14.6)		
HSC	6 (1.7)	5 (1.4)	1 (0.3)	350 (98.3)	356 (32)		
Graduation	5 (2.1)	2 (0.8)	3 (1.3)	234 (97.9)	239 (21.5)		
Postgraduation	0 (0)	0 (0)	0 (0)	15 (100)	15 (1.3)		
Hindu	35 (3.4)	12 (1.2)	23 (2.2)	996 (96.6)	1031 (92.6)	χ^2 0.3 P value 0.85	
Muslim	3 (4)	0 (0)	3 (4)	72 (96)	75 (6.7)		
Others	0 (0)	0 (0)	0 (0)	7 (100)	7 (0.6)		
Urban	24 (3)	10 (1.3)	14 (1.7)	786 (97)	810 (72.8)	χ^2 1.8 P value 0.17	
Rural	14 (4.6)	2 (0.7)	12 (3.9)	289 (95.4)	303 (27.2)		
Hypertension	5 (18.1)	0 (0)	5 (18.1)	57 (91.9)	62 (5.6)	χ^2 118.2	
Diabetes	6 (19.4)	0 (0)	6 (19.4)	25 (80.6)	31 (2.8)		
Hypothyroidism	1 (5.6)	0 (0)	1 (5.6)	17 (94.4)	18 (1.6)		
Others	6 (37.5)	0 (0)	6 (37.5)	10 (62.5)	16 (1.4)		
None	22 (2.2)	12 (1.1)	11 (1.1)	966 (97.8)	988 (88.8)		
None	37 (3.3)	11 (1.0)	26 (2.3)	1070 (96.7)	1107 (99.5)	χ^2 28.5 P value **0.01**	
Consanguineous marriage	0 (0)	0 (0)	0 (0)	1 (100)	1 (0.1)		
Colour vision defect	1 (100)	1 (100)	0 (0)	0 (0)	1 (0.1)		
Others	0 (0)	0 (0)	0 (0)	4 (100)	4 (0.3)		
Yes	5 (41.7)	0 (0)	5 (41.7)	7 (58.3)	12 (1.1)	χ^2 53.8 P value **0.01**	
No	33 (3)	12 (1.1)	21 (1.9)	1068 (97)	1101 (98.9)		
Smoking	3 (7.9)	2 (5.2)	1 (2.6)	35 (92.1)	38 (3.4)	$\chi^2$2.4	P value 0.12
Alcohol	2 (16.7)	0 (0)	2 (16.7)	10 (83.3)	12 (1.1)	$\chi^2$6.5	P value **0.01**
Tobacco	0 (0)	0 (0)	0 (0)	48 (100)	48 (4.3)	$\chi^2$1.8	P value 0.18
None	33 (3.1)	10 (0.1)	23 (2.1)	982 (91.3)	1048(94.2)		

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 05, 2024

Table-2 Impact on Quality of life in patients with Color Vison Defect

Quality of life	Total CVD (n =38)	Congenital CVD (n=12)	Acquired CVD (n=26)	Professional	Shop/ Business/ farm/clerical	Skilled worker	Unskilled worker	Unemployed (housewife/ student/retired)
Daily activities	31 (81.6)	11 (91.7)	20 (76.9)	0	40%	19%	0	29%
Work	30 (78.9)	11 (91.7)	19 (73.1)	0	78.5%	66.7%	0	76.9%
Emotional	36 (94.7)	11 (91.7)	25 (96.1)	0	80%	70%	0	30%

Table-3 Multivariate analysis of various factors with color vision defect (congenital + acquired)

		OR	95% CI	P value
Age	7 – 14	Ref	-	-
	15 – 30	**1.4**	**1.01-3.6**	**0.01**
	30 – 45	**3.4**	**1.2-5.9**	**0.01**
	>45	**8.8**	**2.0-38.1**	**0.01**
Gender	Male	**2.99**	**1.5-6.1**	**0.003**
	Female	Ref	-	-
Occupation	Professional	0.57	0.20-1.6	0.29
	Shop/Business/farm/clerical	0.26	0.02-2.8	0.26
	Skilled worker	0.8	0.3-1.9	0.57
	Unskilled worker	0.99	0.16-5.2	0.91
	Unemployed	Ref	-	-
Education	Illiterate	1.5	0.03-7.8	0.83
	<SSC	1.3	0.28-5.8	0.19
	SSC	1.8	0.1-2.3	0.42
	HSC	1.02	0.02-4.7	0.99
	Graduation	1.3	0.03-6.1	0.88
	Post graduation	Ref	-	-
Religion	Hindu	2.6	0.05-6.6	0.46
	Muslim	3.9	0.04-8.1	0.54
	Christian	Ref	-	-
Locality	Urban	0.83	0.43-1.6	0.59
	Rural	Ref	-	-
Risk factors for acquired CVD		0.84	0.03-2.5	0.92
Family history		1.6	0.7-3.1	0.96
Drug history		**2.3**	**1.9-7.7**	**0.001**
Smoking		1.5	0.4-5.5	0.57
Alcohol		**3.6**	**1.4-6.9**	**0.001**
Tobacco		0.19	0.02-2.1	0.17

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 05, 2024

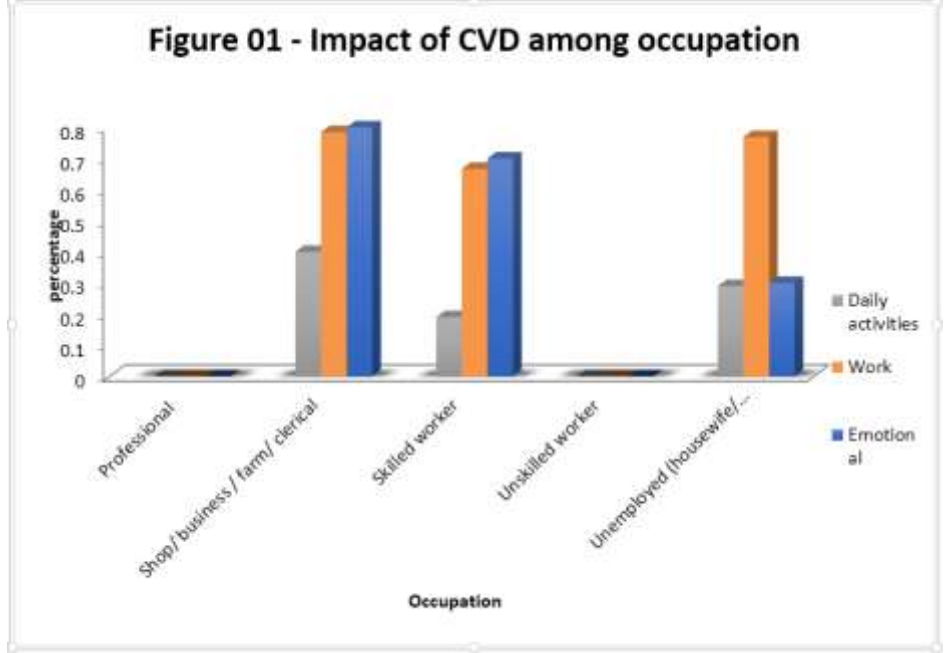

Figure: 1

DISCUSSION

Screening for colour vision is especially important in children as it may be associated with learning difficulties and impaired socialization. However, as the age advances, young patients with colour vison defect might be at a disadvantage especially in making carrier choices as well as their performance might be affected. Thus it is important to screen individuals for presence of colour vison defect as early as possible so as to help the individuals in making career choices and reduce associated psychological stress. In some countries (like Australia), screening of colour vison is mandatory component of school eye-screening program, however, in India screening for colour vison in schools is still not mandatory.[10]

In our study, out of the 1113 patients screened colour vision defect was found in 38 cases i.e. 3.4%. and the proportion of congenital CVD cases was found to be 1.1% whereas that of acquired CVD was 2.3 %. Our findings were supported by findings of a study by **Alrasheed SH et al (2017)** in Sudan on 1100 subjects who found combined CVD among 5.5% cases.[11]

In our study congenital CVD was found in 1.1% cases. **MehraKM et al (1963)** study showed congenital colour vision defect in 2.8% cases in a cross sectional study in Banares, India on 1500 subjects[2]. Our study findings were also supported by the findings of cross sectional study by **Viola Andin et al (2016)** which showed a prevalence of congenital CVD as 1.3% among among first-cycle students of the Faculty of Medicine and Biomedical Sciences of the University of Yaoundé.[12] **Sutender Naresh et al (1994)** found a prevalence of congenital CVD of 1.9% in their study in Patiala on 2097 subjects.[13] Also in a study done by **Reddy AV et al (2017)**, where the authors observed colour blindness in 1.9% among school children in Guntur.[14] **Gupta S et al (2017)** observed overall prevalence of congenital colour blindness as 2.5% in private schools in Bhopal.[11] In our study, majority of subjects belonged to age range of 15 to 30 years (47.2%) at the time of screening where mean age of subjects was 27.9±17.9 years The age at presentation of colour vison defect depend upon the type of colour vision defect and health seeking behaviour of the individual and guardians. i.e. cases with congenital colour vison defect may present at any age and age at presentation in cases with acquired colour vison defect

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 05, 2024

depend upon multiple factors (like severity of ocular disease, knowledge about the cause, patient vigilance, availability of health care facilities etc).

Though we observed no significant association of colour vison defect with age on univariate analysis, multivariate analysis revealed significantly higher odds of colour vison defect with advancing age, i.e. the odds of having CVD were lower in 15-30 years (OR = 1.4; 95% CI=1.01-3.6) than 30-45 years (OR =3.4; 95% CI=1.2-5.9) and further increase in risk above 45 years (OR=8.8; 95%CI=2.0-38.1) as compared to patients of less than 15 years. Our study findings were concordant with the findings of **Hashemi H et al (2017)**, in which the authors observed significantly higher risk of CVD with advancing age.

The colour vision defect has been reported in higher proportions of males as compared to females.[2] In our study, though almost equal proportions of males 599 (53.8%) and females (46.2%) were screened for colour vision defect, the proportion of colour vision defect was observed in significantly higher proportions of males (5.1%) as compared to females (1.3%). Similarly, the risk of color vison defect in males was higher as compared to females on multivariate analysis also (OR- 2.99; 95% CI 1.5-6.1, $p<0.05$). Similar findings on multivariate analysis in a study by **Alrasheed et al (2017)** was found where CVD was higher among males 49 (9.0%) (95% CI, 7.4–10.6) subjects than females 12 (2.2%) (95% CI, 0.6–3.8).[11]

In our study Congenital CVD was found in 2.1% males whereas no female was found to have congenital CVD, thus confirming the male predominance and inheritance. Similarly, **Gupta SC et al (2017)** in their study in Bhopal documented higher prevalence of colour blindness in boys (4.2%) as compared to girls (0.59%).[15]

Congenital colour vision defect is in higher proportion in Muslim population due to practice of consanguineous marriages.[16] In our study, majority of cases screened belonged to Hindu religion whereas only 6.7% cases belonged to Muslim population. Colour vision defect in Muslims (4%) as compared to Hindus (3.4%) but all 12 congenital CVD cases were Hindus and all cases in Muslim population were of acquired CVD which were incidental thus the observed association was statistically insignificant. Also no significant risk could be observed on multivariate analysis. Thus the difference in study results could be attributed to cultural variation in our region than those of other studies.

The present study was conducted at tertiary care centre located in outskirts of the city, which caters the population from not only urban & semi-urban area but patients from nearby villages also seek care. Majority of patients in our study were residents of urban area (72.8%) while 27.2% were from rural areas. The proportion of colour vision defect was observed in rural areas was 4.6% as compared to urban areas 3%. We observed no significant risk of colour vision defect in patients residing in urban areas as compared to rural areas (OR 0.83; CI=0.43-1.6, $P>0.05$). **Chakraborty A et al (2015)** documented the prevalence of colour vision defect in 4.06% in rural areas, supporting the findings of present study.[17] In our study the congenital CVD cases were concentrated more in urban areas i.e. 10 cases (1.3%) which was similar to findings of **Krishnamurthy SS et al (2021)** in which the odds of colour vision defect was observed in significantly higher proportion of cases residing in urban areas (OR 1.90; 95% CI 1.69 to 2.13; P 0.001).[18]

In our study we tried to categorise occupation of our subjects as per Kuppuswamy socioeconomic classification[19,20] and then analyse the distribution of colour vision defects among them. As specified previously, the presence of colour vision defect may hamper the career choices of the individual or difficulty in doing work related to occupation might be the factors associated with seeking care. In our study, the highest proportion of colour vision defect

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 05, 2024

was noted in unskilled workers (8.8%) followed by those engaged in shop/business/farm or clerical work (5.6%). **Fareed M et al (2013)[12]** documented the significance of absolute colour matching in various occupations such as those involved in industries (skilled or unskilled), transport, defence and other occupation. **Singh AK et al (2021)[21]** described work related difficulties in aspirants for civil aviation and their concern manifested as seeking repeated medical check ups due to failure in screening tests.

In present study, cumulative color vison defect was observed in significantly higher proportions of patients educated less than senior secondary school (6.5%), followed by patients who received education up to senior secondary level (6.1%). Though univariate analysis showed significant association which was more attributed to higher acquired CVD in these lower educational groups i.e. 18(69%) out of 26 cases, but multivariate analysis showed no significant risk in our study. Similar to our study, **Krishnamurthy SS et al (2021)** also documented higher odds of CVD in children of higher secondary school as compared to middle school (OR-1.06; 95% CI-0.97-1.16, P=0.17) but the observed risk was statistically insignificant (p>0.05).[17] In our study 5 out of 12 CCVD cases i.e. 41.7% had education upto higher secondary level and thus seem to have chosen their career path. Similar to our study, Krishnamurthy SS et al (2021) showed that 2.89% of children at the level of higher secondary education who have already chosen a stream of education, were color vision deficient.[18] Thus the status of congenital colour vision defect could affect literacy level and career choices in late diagnosed individuals. The findings of our study were supported by findings of **Chudgar A et al (2012)[22]**, the authors documented that children with colour vision defect usually remain undiagnosed and these children belong to low socioeconomic status, their parents being illiterate have minimal awareness about the disease; thus they have minimum access to education opportunities and have less exposure carrier opportunities.

Our study documented family history of colour vision defect as a significant risk factor associated with colour vision defect i.e. 1 out of 12 CCVD cases (8.3%) but no evidence of relation with consanguineous marriage was found. Similar findings were documented by **Osman S et al (2021)** in a study among 1426 university students in Egypt.

Our study documented statistically significant association of acquired CVD with diabetes (19.4%) as well as hypertension (18.1%) Our study findings were supported by the findings of **Tan NC et al (2017)** on 849 subjects in Pasir Ris estate, in which diabetes and prolonged duration of diabetes with no diabetic retinopathy was significant factor associated with impaired color vision in 22% cases.

Alcohol intake for prolonged duration has been linked with decreased contrast and colour sensitivity. Intake of alcohol may impair visuo-spatial stimuli, mesopic rod and cone temporal processing pathways.[23] In our study, out of various addictions, addiction of alcohol was significantly associated with colour vision defect. On multivariate analysis also chronic alcohol addiction (OD=3.6; 95% CI=1.4-6.9) was significantly associated with higher risk of colour vision defect in our study.

In our study, CBQoL scale was used for assessing the quality of life of patients with colour blindness. All the CVD subjects were given questionnaire based on CBQoL[8] and a questionnaire based study done on 268 CVD subjects among total 4194 subjects studied by **Tagarelli A et al (2000)[9]**.

We observed that in our study, out of 38 cases with colour blindness, emotional aspect was affected in 94.7% cases whereas activities of daily living and work activities were affected in 81.6% and 78.9% cases respectively. When we assessed only congenital CVD cases all three

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 05, 2024

components of QOL were equally affected i.e. 91.7%. Of these 12 congenital CVD patients only 2 (16.7%) were aware of their colour vision deficiency. Among the acquired CVD patients also although all components of QOL were found to be affected i.e. daily activities in 76.9%, work related in 73.1% and emotional component in 96.1% but that could be partly attributed to their associated ocular co-morbidities.

In our study among daily activities, crossing road (traffic signals) was the most commonly affected (68.4%). In a study by **Tagarelli A et al (2001)** found that 38.4% of CVD subjects preferred driving during day time due to difficulties in colour perception in night light[9]. In our study choosing clothes was affected in 42.1 %, in above study it was affected in 23.8%. In our study choosing groceries (57.9%) and ripening of food (28.9%) was also affected similar to the above study where identifying natural colours were affected in 40.4% cases. Our findings (31.6%) were also similar to above study (21.2%) in difficulties found in playing sports by CVD case. In our study appreciating colours of cooked food was affected in 18.4% and in above study it was affected in 31.7% cases. Although there was a difference in difficulty identifying skin colours in our study (28.9%) and the above study (3.3%).

In our study difficulty in performing work (52.6%) was affected the most in work related questions. Similar results were seen in the study by **Tagarelli A et al (2001)** where work related difficulties were present in 68.9% cases.[9]

In our study Emotional aspects of life were the most significantly affected in CVD patients. Feeling depressed was found in majority i.e. 86.8% cases in our study followed by feeling a sense of let down (65.8%) and avoiding colour related conversations (65.8%). To the best of our knowledge no studies have concluded research data regarding emotional component of Qol and hence further studies are required to confirm it.

In our study when we checked for quality of life of congenital CVD cases of various occupations being affected by this problem we found that among them daily activities were most affected in Shop/Business/farm/clerical workers i.e. 40%; work related activities in students i.e 76.9% followed by skilled workers like drivers/teachers/electrician etc i.e. 66.7% and emotional component was affected most in Shop/Business/farm/clerical workers i.e. 80% followed by skilled workers i.e. 70%.

The findings of our study were supported by the findings of **Chan XB et al (2014)**, in which colour blindness was observed as a significant barrier to enter into various occupations affecting the work efficiency of the affected individual.[24] Similarly, **Mashige KP et al (2019)** concluded that impaired colour vision affects many aspects of individual's life including sports, health, occupation and safety.[25]

CONCLUSIONS

Thus to conclude our study, we found that a significant proportion of study population has colour vision defects which are widely distributed among the various demographic groups of the community but the general population is rarely screened for them and thus it remains an under-diagnosed ophthalmic disorder. Colour vision defects can be congenital and acquired.

Congenital colour vision defect is more common in the male population with no significant geographical disparities. Presence of congenital CVD affects career options and literacy level of the affected individuals so earlier screening should be mandatory.

Since it was a hospital based study we also found acquired colour vision defects. The correlation of acquired colour vision defects with drugs, addictions, systemic and ocular diseases has also

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 05, 2024

been established in our study which may or may not be reversible in few conditions but testing and related counselling is helpful to the patients in future.

In our study during the routine screening process we found that most of the affected individuals are unaware of the symptoms and never present as a chief complain in eye opd. Also due to lack of knowledge about the disorder the presentation of suffering individuals is quite at a later age in health facilities. However, majority of the affected individuals suffer from deterioration in their quality of life in various aspects like day to day activities, emotional status and work related difficulties which they try to ignore but cannot compensate. Early detection, proper counselling and rehabilitation of individuals suffering from this ocular morbidity is the need of hour. Hence, screening of colour vision defects with Ishihara charts should be included as a part of routine ocular examination in schools, outreach health care facilities and all medical institutions. There is a need of inclusion of CVD screening in National Programs and for the government to provide better gold standard diagnostic tools for its evaluation.

REFERENCES

1. Birch J; Diagnosis of Defective Colour Vision, 2nd edn. Oxford University Press: Edinburgh,1998.
2. Krishna Swami Mehra. Incidence of Colour Blindness in Indians. Brit.J.Ophthalmology. 1963;47:485
3. Shah A, Hussain R, Fareed M, Afzal M. Prevalence of red-green color vision defects among Muslim males and females of Manipur, India. Iranian J Publ Health, Jan 2013; 42, (1); 16-24
4. Dalton, John. 'Extraordinary facts relating to the vision of colours: with observations. By Mr. John Dalton. Read Oct. 31st, 1794.' Memoirs of the literary and philosophical society of Manchester, Vol. 5, Pt. 1. 1798: 28-45.
5. Nathans et al. Molecular genetics of inherited variation in human color vision. Science. 1986; 232, 203- 210.
6. Simunovic MP. Acquired color vision deficiency. Surv Ophthalmol. 2016 Mar-Apr;61(2):132-55.
7. Birch J. Efficiency of the Ishihara plate for identifying red-green colour deficiency. Ophthal Physiol Opt 1997; 17:403-8.
8. Barry et al. Development and validation of a questionnaire assessing the quality of life impact of colour blindness (CBQoL). BMC Ophthalmology. 2017;17:179
9. Antonio Tagarelli et al. Colour blindness in everyday life and car driving. Acta Ophthalmol. Scand. 2004: 82: 436–442. doi: 10.1111/j.1600-0420.2004.00283.x
10. Mehta B, Sowden P, Grandison A. Does deuteranomaly place children at a disadvantage in educational settings?. Progress in Colour Studies: Cognition, language and beyond. 2018 Nov 15:341.
11. Alrasheed SH, Awad ME, Abdulbagi AA, Abdu M. Congenital and acquired colour vision deficiency among population in North Kordofan State of Sudan. Sudanese Journal of Ophthalmology. 2017 Jan 1;9(1):22
12. Fareed M, Anwar MA, Afzal M. Prevalence and gene frequency of color vision impairments among children of six populations from North Indian region. Genes & Diseases. 2015 Jun 1;2(2):211-8.
13. Sutender Naresh Study of colour blindness in Jat Sikhs. Indian J Physiol Pharmacol 1995; 39(2): 127-130.

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 05, 2024

14. Alla Venkata Pitchi Reddy, G. Ravi Babu and K. Vara Prasad. Prevalence of Colour Blindness in School Children in Guntur City, Andhra Pradesh. Nov 17 IJCMR.Vol 4;(11);2454-7379
15. Subhash gupta et al. The prevalence of colour blindness in middle school student of southern Bhopal.IJMHR.2017;3(5):111-113
16. Ahsana Shah, Ruqaiya Hussain, Mohd Fareed, Mohammad Afzal. Prevalence of Red-Green Color Vision Defects among Muslim Males and Females of Manipur, India Iranian J Publ Health, Vol. 42, No.1, Jan 2013, pp.16-24
17. Chakrabarti A, Chakraborti S. Red-green color vision deficiency and lack of awareness among rural school students in India. Iranian journal of public health. 2015 Jul;44(7):1018.
18. Krishnamurthy SS, Rangavittal S, Chandrasekar A, Narayanan A. Prevalence of color vision deficiency among school-going boys in South India. Indian Journal of Ophthalmology. 2021 Aug 1;69(8).
19. Javitt JC, Wang F, West SK. Blindness due to cataract: epidemiology and prevention. Annual review of public health. 1996 May;17(1):159-77
20. D Mishra. H. P. Singh. Kuppuswamy Socioeconomic Scale : A revision. Indian Journal of Pediatrics, Volume 7- March 2003.
21. Singh AK, Khan MA, Singh A, Maheshwari A. Color vision in civil aviation. Indian J Ophthalmol 2021;69:1032-7
22. Chudgar A, Quin E. Relationship between private schooling and achievement: Results from rural and urban India. Economics of Education Review. 2012 Aug 1;31(4):376-90.
23. Zhuang X, Kang P, King A, Cao D. Alcohol intoxication impairs mesopic rod and cone temporal processing in social drinkers. Alcohol Clin Exp Res. 2015;39:1842–9
24. Chan XB, Goh SM, Tan NC. Subjects with colour vision deficiency in the community: what do primary care physicians need to know? Asia Pacific Family Medicine. 2014 Dec;13(1):1-0
25. Mashige KP, van Staden DB. Prevalence of congenital colour vision deficiency among Black school children in Durban, South Africa. BMC research notes. 2019 Dec;12(1):1-5.