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A study of color vision deficiency in candidates appearing in medical board

KEYWORDS: Color vision deficiency, Ishihara chart, Edridge Green lantern

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ABSTRACT *Introduction:Testing for color vision is a mandatory part of medical examination for various services. While some services require high degree of color perception, others allow candidates with varying amounts of deficits. Approximately 8% of males and 0.4% of females are congenitally color deficient. Materials and Methods: 823 candidates who appeared in the divisional medical board during a period of three years were studied. Ishihara chart was used to screen all candidates and those who gave incorrect answers were further tested by the Edridge Green lantern. Results:65 candidates(13 % of male candidates and 0.8% of female candidates) were found to have color vision deficiency. Only 31(47%) candidates were aware of their disability prior to appearing for the medical examination. 64.6% of those selected for jobs requiring accurate color perception were not aware of their deficit before appearing for the medical examination.Conclusion: A screening test to establish color vision should be undertaken while giving advice regarding career so that educational and other activities might be modified accordingly. Also, there is a need to supplement the existing color vision tests for various services in India, with more objective and reproducible diagnostic tests.*

Introduction

It is estimated that approximately 4% of the human population (8-10% males and 0.4% females) are congenitally color deficient.These individuals, who have no other visual deficit, may pass undetected unless tested for their color perception. Many of the activities of daily life are based on color images and color cues designed on a presumption of universal capacity for trichromatic color vision, thus early diagnosis of color vision defects might allow for early modifications in educational and other activities & future choice of profession.[1] Though many tests for colour vision are available, there is no consensus on the ideal method, with different countries using different tests. Most of the tests are designed to evaluate congenital red-green color vision deficiencies (CVD).

The occupational screening for color blindness probably originated following a fatal railroad accident in Sweden in 1875. The ophthalmologist Frithiof Holmgren suggested that either the engineer or his oiler had been color blind. Though neither survived to be tested, the accident had a central role in the introduction of color vision testing by European and North American railroads and subsequently in other parts of the world.[2]

Testing for color vision is a mandatory part of medical examination required for various services.The selection criteria are laid down after determining the requirements for the occupation. Color deficient people are excluded from employment when safety and efficiency is threatened to be compromised. Though some occupations have laid down guidelines for color vision requirements, often there are no clear guidance to medical examiners as to what the requirements for color vision are in the particular occupation.

We conducted a study of 823 candidates for color vision who appeared in the divisional medical board after getting selected for services in various government organizations.

Materials and Methods

823 candidates who appeared in the Divisional Medical Board during the period of February 2011 to February 2014 were studied. These candidates had cleared the selection criteria for the required services (written examination and /or interview, and an additional physical eligibility test for state police services).The candidates appeared in the divisional medical board either directly or after being referred from the district medical board. The candidates were evaluated for color vision by Ishihara chart. The 38 plate Pseudoisochromatic Chart (Kanehara& Co Japan) was used with the book held at 75 cm under daylight illumination allowing 4 seconds for each plate with the plate perpendicular to the visual line.The plates were given in a random order to avoid answers by memorization.

Candidates who correctly read all plates in the Ishihara chart were labeled as color vision normal.Candidates who gave incorrect answers were further evaluated using the Edridge Green lantern. The lantern has 5 rotating discs each with eight apertures

Disc 1 has different aperture sizes, while Discs 2, 3 and 4 contain

filters with eight colors: two reds, two greens, white, yellow, blue and purple. Superimposition of filters can result in additional colors.

The test was performed at a distance of 16 feet with an exposure time of 5 seconds Correct identification of color with 1.3mm aperture was labeled as High grade of color perception,13 mm aperture was labeled as Low grade of color perception

Results

The mean age of the candidates was 29 years. There were 360 females and 463 males. Out of these, 62 male candidates(13%) and 3 female candidates(0.8%) were found to have CVD. Prior awareness regarding presence of CVD was present in only 28 males and 3 female candidates.49 out of the 65 candidates with CVD had to join services requiring accurate color perception. All the CVD candidates had congenital CVD.

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Table 1 showing number of candidates and candidates with CVD in various services

Position	Candidates examined			Candidates with defective color perception		
	Total	Female	Male	Total	Female	Male
Medical officers	170	81	89	11	2	9
Faculty in Medical Colleges	27	14	13			
Engineers in state electricity Board	48	22	26	1		1
Engineers State engineering services	107	47	60	3		3
Teaching faculty engineering college	15	6	9			
Accounts officer	36	10	26	2		2
Law officers	37	15	22			
Officers State AdministrativeServices	17	5	12			
Teaching faculty in law college	12	5	7			
Dist Judges	22	7	15			
Police officers	40	38	2			
Civil Judges	74	30	44			
Teaching faculty elsewhere	93	50	43			
Drivers of govt vehicles(referred)	4		4	4		4
Police constables (referred)	58		58	39		39
Forest Guards (referred)	7	3	4	4	1	3
Others	56	27	29	1		1

Table 2 showing candidates with previous awareness regarding presence of CVD

	Total	CVD	Female		Male	
			Total	Previous awareness	Total	Prior awareness
Medical officers	170	11	2	2	9	9
Engineers in State Electricity Board	48	1	1		1	1
Engineers in state engineering services	107	3			3	2
Accounts officers	36	2			2	-
Drivers of government vehicles (referred)	4	4			4	2
Police constables	58	39			39	11
Forest guards	7	4	1	1	3	2
Others	56	1			1	1

Only 31(47%) candidates were aware of their disability prior to appearing for the medical examination.

Table 3 showing number of candidates with previous awareness of CVD in jobs requiring accurate color perception

Service	Total number	CVD	Awareness present	No previous awareness
Engineers in state Electricity board	48	1	1	
Drivers of government vehicles	4	4	2	2 (50%)
Police constables	58	39	11	28 (72%)
Forest guards	7	4	3	1 (25%)
Total	117	48	17(35.4%)	31(64.6%)

64.6% of the candidates selected for jobs requiring accurate color perception were not previously aware of their disability.

DISCUSSION

CVD was found in 13% of males and 0.8% of female candidates appearing in the medical board. The relatively high prevalence of CVD in our study is because many of the candidates had been referred to us from the district medical board for confirmation and further evaluation. All the candidates had congenital red-green color vision deficiency. Only 35.4% of those with CVD and selected for services requiring accurate color perception were previously aware of their disability. The rest 64.6% came to know about their disability only on appearing for medical examination after having cleared the selection procedure for the services, reflecting the lack of awareness of the condition.

The Ishihara test is quick and easy and is an excellent screening tool to detect those with red-green color vision abnormality. However,it is not ideal because it is difficult to standardize and insensitive.Many patients with normal color vision make errors, also it has a limited ability to classify color vision deficiency and determine its severity.[1] Many organizations like Railways, Civil Aviation, Navy and Airforce require the correct recognition of colored signals. A lantern test which imitates actual signal systems simulating the work place is an essential part of medical examination for these services.While the armed forces and civil aviation services use the Martin lantern, the Edridge Green lantern is in use for civil services. However, lanterns do not specifically screen for colour defects. The general design of lanterns has not changed very much since their creation in 1891 and they are not in production since the early 20th century. Except for the Farnsworth lantern used in the US, the lanterns have not been stand-

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ardized and there are scarce studies for their validity and reliability.

The Farnsworth Panel D-15 and Farnsworth-Munsell 100-hue tests, are much more accurate in classifying color deficiency. Farnsworth Panel D-15 Test is considerably quicker and more convenient test for routine clinical use. Though not very sensitive, its speed and accuracy make it useful. The relative insensitivity can also be an asset in judging the practical significance of mild degrees of color deficiency. For example, individuals who fail the Ishihara plates but pass the D-15 panel will probably not have color discrimination problems under most circumstances and in most jobs .[3] **NagelsAnomaloscopes is** considered the gold standard for colour vision testing in clinical research, however it is an expensive instrument requiring an experienced examiner's skills.The Heidelberg Multicolour Anomaloscope (HMC) is a microprocessor controlled computerised test based on same principle as Nagels, which is easy to understand and generates results automatically.[4]

Attempts have been made to develop methods of color vision testing based on PC based software.[5,6] Software based alternatives with exact reproduction of the spot sizes and colors of the original Martin lamp are being studied for validation in the armed forces.[7] These methods will eliminate various factors like filter degradation which occurs in lanterns over the years. Similarly, the Ishihara charts in use are highly variable in colors and plate qualities leading to ambiguous results. Consistent and accurate color projection will make a PC based test reproducible and repeatable . However monitor characteristics will need to be standardized.

In the technical services category of Indian civil services, which includes police services, higher grade of color vision is essential. Color vision is graded into higher and lower grade depending on the size of the aperture in the Edridge Green lantern (1.3mm vs 13mm).[8] The United States police service no longer implements a colour vision standard, though monochromats are barred. [9] Those who fail initial color vision screening by pseudoisochromatic plates should be further evaluated by anamaloscope or D-15 test to include anomalous trichromats who are the most numerous amongst the CVD persons.

A screening test to establish color vision can be advised while career decision is being taken especially for those occupations where color judgment is important. If CVD is diagnosed early, educational and other activities might be modified accordingly to avoid unpleasant surprises later in life. Also, there is a need to supplement the existing color vision tests for various services in India, with more objective, diagnostic tests.The existing protocols for testing need to be reviewed and standardized with the introduction of software based tests.

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