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Prevalence of Color Vision Deficiency among Students in Hajand and Amad High Schools in Shekhan City

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Abstract: ***Color vision deficiency is a condition affecting human's ability to see or recognize specific colors. It is mostly genetic, X-linked recessive inheritance and thus, is more common among males than females. This cross sectional study was done to find the prevalence of color vision deficiency among high school students in Shekhan city and to find the relation of color vision deficiency with different races. The study has been conducted in two high schools that were present inside Shekhan city at the time of the study (Amad high school for males and Hajand high school for females). All students screened by using Ishihara 24 plates. 640 students (283 males, 357 females) were screened. Students' age range (15-22 years), the Mean age for males 17.50 years and for females 17.13 years. The prevalence of Color Vision Deficiency was 6.36% among males and 0.84% among females. The most common types of Color Vision Deficiency among males were deuteranomaly (10cases), protanomaly (5 cases), deuteranopia (2 cases) and protanopia (1 case). There was no significant difference between races and color vision deficiency. Similar to dyslexia, before it was well known and well understood, color vision deficiency is an invisible disability and can lead to students becoming disappointment with learning or feeling that they are moronic or less cable than others. It can provide erroneous rules for learning and indeed, even influence how well they do in their exams and consecutively their choice of career.***

Key words: Color Vision Deficiency, Ishihara color test, High school students , and Shekhan city.

1. INTRODUCTION

Color Vision Deficiency (CVD) is the failure to determine some colors under normal lighting circumstances. It takes place when one or more of three types of color sensitive cone cells (red, green and blue) do not perfectly gather or send the proper color signals to the optic nerve. It may be congenital or acquired. The congenital type usually inherited and linked to the X chromosome (red-green color blindness) and thus, more frequent in males than females, but also it may be commonly an autosomal dominant trait (blue-yellow color blindness) and very rarely an autosomal recessive inherited trait (Achromatopsia) [1-3]. Congenital type is non-pathologic, incurable, and fixed during the whole life. Acquired color vision deficiency frequently results from disease or injury that damages the optic nerve or retina can also cause loss of color recognition. Main diseases that can cause color deficits are diabetes, glaucoma, degenerative diseases, and the toxic effect of medications, trauma, and aging process [4]. Congenital color blindness may be divided into two main types: Dyschromatopsia or Achromatopsia {which is either a rare condition in which no cone cells available or just one type of them}. Dyschromatopsia (defect in color vision) can be classified into two main types:

a. Anomalous trichromatic color vision, all the three primary colors is present but there is defective for one or two of them. It may be subdivided into three types:

- Protanomalous: It means defective red color perception.
- Deuteranomalous: It refers to defective green color perception.
-Tritanomalous: It implies defective blue color perception.

b. Dichromatic color vision. The ability to perceive one of the three primary colors is entirely absent. It may be also subdivided into further three types:

-Protanopia: It means a complete red color defect.
–Deuteranopia: It means complete defect for green color.
–Tritanopia: It means the absence of blue color appreciation.

Red-green deficiency (protanomalous, protanopia, deuteranomalous and deuteranopia) is more common. Blue deficiency (tritanomalous and tritanopia) is relatively rare [5]. The red-green type has a high prevalence in Caucasian populations, commonly identified as being 8% of men and 0.4% women. It is recognized to have lower prevalence in non-Caucasian populations [6]. The prevalence of CVD is 4% in Japan, 6.5% in China [1], 4% in African countries, 7.3% in Turkey, Iran (4.7%), India (2.8% to 8.2%, ethnic variations), Saudi Arabia (2.9%) [7]. The prevalence of CVD in Erbil province, Kurdistan Region has been studied by Kareem and Saleem in 2013.They conduct a study to find out the prevalence of CVD among students of different educational levels in Erbil city. They found (8.47%) of male students and (1.37%) of female students had CVD [8]. There is no any report or document about the prevalence of CVD in Duhok province, so this study was done to give an initial reference of CVD in this Province especially in Shekhan city, where different ethnics lived together.

2. SUBJECTS AND METHODS

This was a cross-sectional study conducted in Shekhan city, Duhok province, Kurdistan Region, Iraq. Shekhan city is located southeast of Duhok city and is a city of coexistence of different ethnic groups, religions, and sects. In this city Muslim Kurds, Yazidi, Arabs, and Christians are lived together. It's population about (57000). At the time of the study, there were two high schools inside Shekhan city (Amad for males and Hajand for females). All students of both schools in grades 10-12 are included in the study. Our major outcome measure was color vision deficiency, which was tested by using Pseudo-isochromatic Ishihara color test; it is a quick method of screening color blinds from the normal. The Ishihara book of 24 plates was caught parallel to the face at a distance of 75 cm from the student, vertical to the line of vision. The test was performed for the enrolled students in a classroom, which should be illuminated sufficiently by daylight. Each plate was presented to the student for three to five seconds and they were requested to read the numbers. The student was requested to read the numbers seen on the test plates 1 to 17. An evaluation of the reading of plates 1 to 15 determines the normality or deficiency of color vision. If 13 or more plates are read precisely, the color vision considered as normal. If only nine or less than nine plates are read precisely, the color vision was considered as red green deficient. The plates 16 and 17 are used to discriminate protan and deutan types of color vision efficiency [9].If the person is unable to read numerals, plates 18-24 are used and the winding lines between the two X's are traced. Each tracing should be completed within ten seconds. The answers given by the persons were documented in a specially prepared questionnaire form, which contains information like age, class, and type of red-green deficiency (if observed). In addition to this, other information is obtained like ethnicity, religion, the degree of relationship (consanguinity) between parents, Data were entered and analyzed using software program Statistical Package for the Social Sciences version 23. Frequency, percentage, means and standard deviation were used for categorical variables. Chi- square tests were used to assess statistical significances. A p-value of $\leq$ 0.05 regarded as statistically significant.

3. RESULTS

Overall of 640 persons including (283) male students and (357) female students, their age ranged between 15 to 22 years, finished the study. Mean age of males (17.50) years and females (17.13) years. Distribution of students according to scholastic years (classes) were 218(34.1%), 189(29.5%) and 233(36.4%) for stage10-12 respectively. Ethnic distribution of the population was (84.4 %) Kurdish Muslim, (15.2%) Yazidi and (0.5%) Christians. The degree of parents' relationship (consanguinity) has been assessed. Parents with first, second and third-degree cousin-hood regarded as closely related, and others regarded as with no any close relationship. 17.8 % of students have parents with a close relationship. Kurdish Muslim has the highest percentage 39.3% .Table.1.

Table 1. Distribution of Study Sample by religion and consanguinity.

Ethnics	**Parents with closed relationship**				**Total**	
	Yes		**No**			
	No.	**%**	**No.**	**%**	**No.**	**%**
Kurdish Muslim	212	39.3	328	60.7	540	100.0
Christian	1	33.3	2	66.7	3	100.0
Yazidi	29	29.9	68	70.1	97	100.0
Total	242	37.8	398	62.2	640	100.0

The study showed that the prevalence rate of CVD among male students in Amad High school in Shekhan city was (6.36%) and among female students in Hajand High school was (0.84%).

Eighteen cases of CVD are Kurdish Muslims, 3 cases Yazidian and no cases of CVD are reported among Christian students. There is no significant statistical association between different ethnic groups and prevalence of CVD (P. value =0.943). Table .2.

Table 2. Distribution of studied population and cases of CVD according to ethnic groups and gender.

Ethnic groups	**No. of screened students**		**CVD n (%)**		**P. value**
	Male	***Female***	***Male***	***Female***	
Kurdish Muslim	244	296	16(6.56)	2(0.68)	0.943
Yazidi	37	60	2(5.41)	1(1.67)	
Christian	2	1	0	0	
Total	283	357	18(6.36)	3(0.84)	

Cases of CVD among male students are distributed into four types of color blindness: 5 (1.77%) red color weakness (protanomaly), 10 (5.53%) green color weakness (deuteranomaly), 1(0.35%) red color deficiency (protanopia) and 2(0.71%) green color deficiency (deuteranopia), while female students are distributed into only two types 1 (0.28%) protanomaly and 2(0.56%) deuteranomaly. Table.3.

Table 3. Distribution of students according to the gender, types and severity of CVD.

Gender	*No. of screened students*	*CVD n (%)*	**Protanomaly n (%)**	**Deuteranomaly n (%)**	**Protanopia n (%)**	**Deutanopia n (%)**
Male	283	18 (6.36)	5 (1.77)	10 (3.53)	1(0.35)	2(0.71)
Female	357	3 (0.84)	1(0.28)	2(0.56)	0	0
Total	640	21(3.28)	6 (0.94)	12 (1.87)	1(0.16)	2(0.31)

Table.4. shows that up to (57.12%) of cases of CVD have closed relationship parents' and (42.86%) have not close relationship parents, but this difference is not statistically significant (P. value =0.07).

Table 4. Relation of cases of CVD with parents' relationship.

Parents' close relationship	**CVD**		**Total**	**P. value**
	Yes	**No**		
Yes	12 (57.12%)	230	242	.070
No	9 (42.86%)	389	398	
Total	21	619	640	

4. DISCUSSION

Ishihara plates can only be used to detect and classify red-green color vision deficiencies, which are the most common types of CVD. Ishihara test has the mean sensitivity of 96%, the mean specificity of 98.5%, in addition to it revealed good retest reliability [10]. The color vision deficient person will not just confuse red and green. Because the peak of sensitivity of red and green cone cells is very close to each other. These persons will be unable to discriminate any colors, which contain red or green, for example, they will 'see' purple as blue because they cannot perceive the red part of the light spectrum, which is added to blue to form the color purple. Thus, all reds, greens, oranges, browns, purples, blues and grays will be impossible to identify precisely [11]. This study revealed that prevalence of CVD among male students was (6.36), Three previous studies from Iraq showed results near to this study result , prevalence rate among the students of Erbil City of (8.47) , among adults in Baghdad (6.75), and (8.19) among children from Basrah province[8,12,13]. Results from all these studies situated within the anticipated range for Caucasian males; about 8.0–10.0% of the Caucasian male population is affected [14]. CVD prevalence in neighboring countries are either lower or higher than this study results as (8.72) in Jordan [15] , In Iran, three studies are done in different cities in Qazvin, Zanjan , and Tehran, the prevalence of CVD were varied from 3.49 to 8.7 and 8.8 respectively[16-18],7.3% in Turkey[19], and 2.9-11% in Saudi Arabia[20-21]. In some European countries, in three different studies, the prevalence of CVD among male students in Germany were (7.8), (7.95) among males in Greek and (8.7) among males in Denmark [22-24]. In many studies, only males were selected for detecting prevalence of CVD in the population, as the prevalence of CVD among males may give a nearly precise estimate about prevalence of CVD among female population in accordance with the Hardy- Weinberg equilibrium. In view of CVD, is not a lethal condition, the prevalence should last consistent in a randomly mating population [25]. The prevalence of CVD among female participants in the present study (0.84) is near to other studies done elsewhere. Abundant random population surveys reveal that the prevalence of CVD in European Caucasians is about 0.4% in women [1], in the USA was found to be 0.4-07% [10], 0.83 among Indian population[26].

The present study showed that most cases of CVD among males of deutans type 4.24 (green weakness and red deficiency) and protans 2.12 (red weakness and deficiency) with deutans/protans ratio 2:1. Most studies worldwide showed that cases of deutans more than protans types. In large study in India, researchers found that 7.95% deutans and 3.22% protans [26], In Jordan, 12 of cases of deutan and 7 cases of protans[15], In Nepal , 16 cases out of 19 cases of deutan types [27] , In study done in Philippine , (78.95%)of cases of CVD of deutan types[28]. In Erbil, cases of deutans are slightly more than cases of protans [8].while a Turkish study has reported about 5.10% protans and 2.23% deutans among male [29]. Because, the CVD is inherited the condition, its allocation is likely to be changeable among ethnic groups. Although, the percentage distributions of CVD among ethnics groups in our study were found different and (57.12%) of cases of CVD had parents closely related (consanguineous marriages) but both are statistically not significant. However, Shah et al found high prevalence of CVD among Indian Muslim population which may be related to higher percentages of consanguineous marriages[30], Dahlan and Mostafa investigated CVD among male secondary students in Jizan city in Saudi Arabia , they found significantly higher prevalence of CVD among students who parents' were closely related[31]. Kareem and Saleem concluded that there was no any significant differences among different ethnics in Erbil city for both male and female students regarding the prevalence of CVD [8], another study conducted in China concluded that no significant difference was detected in the prevalence of CVD in males between Uygur and Han nationalities [32]. In the USA, a population-based study revealed that significant ethnicity-related differences in the distribution of CVD among male preschools [33]. CVD is recently being argued. Youth need to know their accurate color vision status before making career choices [34]. Cole [35] emphasized that students should know if they have CVD so they can be assisted more promptly to find adaptive strategies when they planning for their future career.

5. CONCLUSION

The prevalence of CVD among males and females in this study is near to that of Caucasian populations.

Similar to dyslexia, before it was well known and well understood, CVD is an invisible disability and can lead to students becoming disappointment with learning or feeling that they are moronic or less cable than others. It can provide erroneous rules for learning and indeed, even influence how well they do in their exams and consecutively their choice of career. Planning for the involvement of color vision testing methods in school health screening programs can be helpful in improving the quality of life in affected persons.

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