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Prevalence of Congenital Red-Green Color Vision Defects among Various Ethnic Groups of Students in Erbil City

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Abstract

The incidence of color blindness varies from race to race and in different geographical area. Since, there is no such report about the prevalence of color blindness in the Kurdistan region (North of Iraq), the present study had been conducted to find out the incidence of color blindness among preliminary, secondary and college students of Erbil city, Kurdistan region – Iraq. Participant's (n=1856, 1275 males, 581 females, age group 7 to 25 years) color vision was tested by using Ishihara chart. Among 1275 male students, 108 students (8.47%) were found to be color blind: 42 of them showed deuteranomalia, 39 protanomalia, 20 deuteranopia and 7 protanopia. Among 581 female students, 8 females (1.37%) were found to be color blind: 5 of them showed protanomalia, 2 deuteranomalia and 1 deuteranopia. Data observed by Chi-square test showed there was no significant difference between ethnic groups of both male and female students. Studies on color blindness in Kurdistan region are very few; we hope this student-based investigation is meant to fill a gap in this field.

Keywords: Color Vision Deficiency, Ishihara Color Test, Ethnic Groups, Erbil City.

1. Introduction

Color blindness is an abnormal condition characterized by the inability to clearly distinguish different colors of spectrum. Human color vision is normally trichromatic i.e. the mixture of red, green, and blue lights (Curcio *et al.*, 1990). Most color vision defects are congenital and permanent. Red-Green defects (Protan and Deutan) show the highest prevalence in the general population (Citrik *et al.*, 2005). Impaired color vision, in the case of red-green color blindness, is genetically determined by X-linked recessive inheritance and thus occurs in males but is transmitted via female and about 8.0% of all women are carrier of it (Guyton and Hall, 2005). The genes responsible for red-green Color vision deficiency are located on the long arm of the X-chromosome within the Xq28 band (Deeb and Kohl, 2003; Filosa *et al.*, 1993; Norn, 1997), while the blue pigment gene resides on the 7th chromosome (Deeb and Kohl, 2003; Deeb, 2004; Motulsky, 1988). Being a genetic disorder, the incidence, of color blindness, varies from race to race and different in different geographical regions of the world inhabited by people of different ethnicity (Rahman *et al.*, 1998). John Dalton was the first scientist to give a clear description of his affliction of color blindness in 1798 (Sutender, 1995).

Color blindness is one of the extensively studied genetic marker in the study of human variation and it is an important genetic trait in the field of human genetics. It has been suggested that natural selection operates in higher intensity color vision deficiency among many primitive populations (Pickford, 1963; Roberts, 1967).

classification of the color vision deficiency

Protanomaly	Red weakness
Deuteranomaly	Green weakness
Tritanomaly	Blue weakness
Protanopia	Red deficiency
Deuteranopia	Green deficiency
Tritanopia	Blue deficiency
Achromatopia	Absolute color blindness

In a normal trichromat, three wavelengths are required to match wavelength. Dichromacy occurs when there are only two cones functioning. Monochromats and achromats only need one wavelength to match the reference color. A mild color deficiency is present when one or more of the three cones function "poorly". A more sever color deficiency is present when one of the cones does not function at "all" or is missing. Red green

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deficiency is by far the most common form of color blindness. The scientific basis for the same is that, DNA sequences of the red and green receptor gene are so similar, that it is easy for mistakes to occur during the development of egg and sperm, as genetic material is replicated and exchange between chromosomes. Those with a less common type have difficulty distinguishing blue and yellow. In very few cases, color deficiency exists to an extent that no colors can be detected; only shades of black, white gray are seen (Tortora and Grabowski, 1996; Foster, 1991).

The incidence of color blindness has been reported from various populations of several countries. There is no report of such study undertaken about the prevalence of color blindness of the Kurdistan Region of Iraq. So the present study had been conducted to find out the incidence of color blindness and racial difference of it among the students of Erbil city, Kurdistan region, North of Iraq.

2. Materials and Methods

This study was carried out among students of some preliminary and secondary schools (Fenk, Ishk, Fatema Zahra, Ankawa, Bablian and Halgurd) and also colleges of University of Salahaddin in Erbil city. From these schools and colleges total number (1856) individuals: (1275) males and (581) females with the age (7-25) and belonging to various ethnic groups: 1090 Kurdish, 269 Arabic, 240 Turkman and 260 Kldan were tested for color vision deficiency.

This study was done with the help of Ishihara chart. This chart consists of polychromatic plates containing printed figures made up of colored spots on a background of similarly shaped colored spots. The figures are intentionally made up of colors that are liable to look the same as the background, to an individual who is color-deficient. The color vision testing plates are held at (75 cm) from the student and tilted at right angle to the line of vision. The tests were performed binocularly in sufficient indirect daylight as recommended by Ishihara. The color Ishihara chart was shown to all participants and they were asked to read the impressions in the color chart. The impression perceived by a person with normal color vision was different from the impression perceived by a person with color vision deficiency. The types of color blindness were differentiated with the help of key provided with the chart.

3. Results

This study was performed on healthy preliminary, secondary school and college students to determine the prevalence of congenital color blindness in Erbil city.

A total of 1856 participants including 1275 males and 581 females with age range from (7-25) years completed the study.

From the data obtained into Table 1 (8.45%) of Kurdish, (9.44%) of Arabic, (8.52%) of Turkman and (7.40%) of Kldan male students were found to have congenital color vision defective with variation in different types of color blindness: red weakness (protanomaly), green weakness (deuteranomaly), red deficiency (protanopia) and green deficiency (deuteranopia).

The results for ethnic variation among females under study are shown in the Table 2 (1.20%) of Kurdish, (2.24%) of Arabic, (1.56%) of Turkman and (1.05%) of Kldan female students were found to have congenital color defective with variation in different types of color blindness.

The distribution of different types of color blindness among male students of the present study is presented in Figure 1. Among the color blinds, 42, 39, 20 and 7 male students were the victims of Deuteranomaly, Protanomaly, Deuteranopia and Protanopia respectively.

The comparisons between ethnic groups were showed no significant difference using Chi-square test, in both male and female students.

Table 1. The percentage of phenotypic frequency of the different types of color vision deficiency among male students of different ethnic groups

Male							
Ethnic Groups	**No. studied**	**No. defected**	**Defected color vision %**	**Red weakness%**	**Green weakness%**	**Red deficiency%**	**Green deficiency%**
Kurd	757	64	8.45	3.17	3.43	0.52	1.32
Arab	180	17	9.44	3.33	2.77	1.11	2.22
Turkman	176	15	8.52	2.84	3.40	0.56	1.70
Kldan	162	12	7.40	2.46	3.08	0	1.85
Total	1275	108	8.47	3.05	3.29	0.54	1.56

Table 2. The percentage of phenotypic frequency of the different types of color vision deficiency among female students of different ethnic groups

Female							
Ethnic Groups	**No. studied**	**No. defected**	**Defected color vision %**	**Red weakness %**	**Green weakness %**	**Red deficiency%**	**Green deficiency%**
Kurd	333	4	1.20	0.6	0.3	0	0.3
Arab	89	2	2.24	1.12	1.12	0	0
Turkman	64	1	1.56	1.56	0	0	0
Kldan	95	1	1.05	1.05	0	0	0
Total	581	8	1.37	0.86	0.34	0	0.17

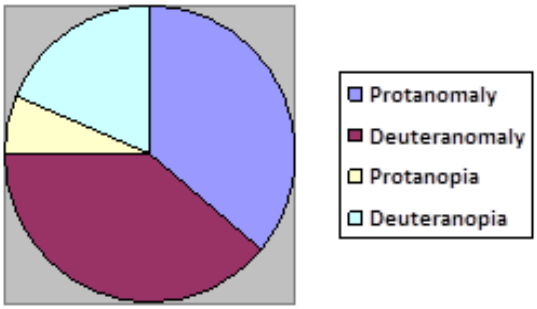

Figure 1. Percentage distribution of different types of color blindness among male students of the present study

4. Disscusion

The percentage distributions of color blindness in the different ethnic groups and countries are found to be variable: in our study the prevalence of color blindness among the male students (8.46%) were found to be similar recorded in America, 8.0% (Mueller and Young, 1995), Tehran, 8.18% (Modarres *et al.*, 1996), Iraq, 8.19% (Al-Amood *et al.*, 1981), Denmark, 8.7% (Norn, 1997), Jordan, 8.72% (Al-Aqtum and Al-Qawasmeh, 2001) and India, 8.73% (Shah *et al*., 2013). However, the prevalence of the color blindness among male students in our present study is higher than that of Pakistan, 1.1% (Alam *et al.*, 2008), India, 1.12% (Dakshayani and Gangadhar, 2006), 2.4% (Kalamma *et al.*, 2008) and 2.4% (Luxmi and Kapooe, 2011), China, 3.0% (Huang *et al.*, 1990), Nepal, 3.8 (Niroula and Saha, 2010), Philippine, 5.17% (Cruz *et al.*, 2010) and Malaysia, 6.7% (Balasundaram and Reddy, 2006).

In the present study the prevalence of color blindness among female students (1.37%) were found to be similar with some researches done in Saudi Arabia 0.75% (Oriowo and Alotaibi, 2008), Aligarh and Simla 0.8% (Rahman *et al.*, 1998), India 1.04% (Mehra, 1963), Punjab 1.1% (Bansal, 1967) and India, 1.69% (Shah *et al*., 2013).

Since the color blindness is genetically transmitted, its distribution is likely to be variable in different ethnic groups. The percentage distributions of color blindness in our study were found different in different ethnic groups: highest in Arab male students (9.44%) and female students (2.24%) these results are similarly recorded by Al-Amood *et al* in 1981 among Arabs of Iraq. The higher prevalence rate of color blindness may be due to the hidden effect of consanguineous marriages.

Although several therapies have been proposed (e.g. electrical eye stimulation, Iodine injections and large doses of vitamins), there are no treatments or surgical procedures to improve the quality of an individual's chromatic vision (Richer and Adams, 1984).

Detection of color blindness at an early age can be extremely useful to avert or prevent certain occupational hazards, including death in the case of drivers of locomotives and automobiles.

In order to find out the exact incidence of color blindness among the different ethnic groups in Kurdistan region, a further study with a large sample is necessary.

5. Conclusion

This survey should serve as a call for other researchers to carry out more work on color vision deficiency in Kurdistan and Iraq. Also the information on red-green defection among males and females in Kurdistan has been lacking. The present study found the prevalence rate of (CVD) in Erbil city male students (8.46%) and female students (1.37%).

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Literature that describes the prevalence of inherited red-green color deficiency in different populations is reviewed. Large random population surveys show that the prevalence of deficiency in European Caucasians is about 8% in men and about 0.4% in women and between 4% and 6.5% in men of Chinese and Japanese ethnicity. Background: The prevalence of congenital colour vision deficiency (CCVD) varies from race to race and differs in different geographic regions. Colour vision deficiency or colour blindness, is the inability or decreased ability of discriminating certain colour combinations and colour differences under normal lighting conditions.Â There was clear variation in the prevalence of colour vision deficiency among students of various ethnic groups. Proper screening, education and counseling are needed to minimize impacts of CCVD in the country, and can also be beneficial for the affected subject in tackling difficulties in everyday work and for proper choice of future profession.Â prevalence and allele frequencies of red-green colour vi-. sion defects among students at Hawassa University Prevalence of Red-Green Color Vision Defects among Muslim Males and Females of Manipur, India.Â 24. ï¶ Congenital color vision deficiency (CVD) is an X chromosome-linked recessive, autosomal dominant and very rarely autosomal recessive inherited trait. ï¶ Red-Green defects (Protan and Deutan) show the highest prevalence in the general population. ï¶ Impaired color vision, in the case of red-green color blindness, is genetically determined by X- linked recessive inheritance and thus occurs in males but is transmitted via.