

Prevalence And Allele Frequency Of Colour Blindness In Al-Najaf Al Ashraf Province

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ABSTRACT

Background: Colour blindness or colour vision deficiency is an inability or reduced ability to described certain colours, there are several types of colour blindness but the more common type red-green colour blindness that inherited x-linked disorder, hence it was more distribution in males (hemizygote) but it was less prevalent in females because she had two x chromosomes, she may be affected or a carrier to disorder. We examined 2470 participant (2158 male and 312 female) by using Ishihara plate (24 plates edited). **This study conducted** to find out the prevalence of colour blindness in Al-Najaf province. In the present study, Among those was screened for colour deficiency, 107 of them(4.33%)were diagnosed with colour blindness, the rate was a difference among gender 105(4.87 %) in male and it was 2(0.64) % in female. The deuteranomaly was the highest type 38(35.51%) then deuteranopia was 31(28.97 %), the protanomaly was 23(21.50%), the protanopia was 10(9.35%), At last, the achromacy was lowest 5(4.67 %) among infected colour blindness. The deutan :protan ratio was 2.03:1. This rate (in our study) was approximately similar to the rate recorded in Al-Qadisiyah University (5.2 % in male and 0.4% in female) and less the rate in the centre and north Iraq (Baghdad, Duhok and Erbil province).

Keywords: Colour Vision Deficiency, Colour Blindness, Deutan, Protan, Pseudoisochromatic Plates, Ishihara Test And Al- Najaf Province.

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INTRODUCTION

The normal colouration of human vision is mediated by three cone photoreceptor classes: a blue or wave sensitivity (S), a medium wave or a green wave sensitivity(M) and a long-wave or a red wave sensitivity. (Moudgil 2016). Colour Vision Deficiency (CVD) means that certain color combinations and changes in color cannot be distinguished under normal conditions of lighting. There are two types of colour vision defects: first, most cases are congenital and permanent ,second, there are acquired color vision defects in rare cases (Cumberl *et al*, 2005).

Red and green colour defects (protan and deutan)show the highest incidence in the world, red and green colour blindness is genetically determined by recessive X-linked genes within the distal part on q arms on locus (Tagarelli, Piro, and Tagarelli 1999) (Geletu, Muthuswamy, and Raga 2018), While on autosomal chromosome7 the Blue Pigment gene is 7q32 (Ooe *et al*. 2018). Factors such as optic nervous damage, metabolic disorders like diabetes, diseases of the eye (glucoma, macular

degradation) and chronic diseases may cause acquired CVD (such as sickle cell anemia) (Ross, 1962). Generally, there are two kinds of defects protan and deutan,in case the absence of L (red) cone pigment or M (green) cone pigment will produce protanopia and deuteranopia, respectively. The other case if there is an abnormality in the L or M cone pigment that would produce protanomaly and deuteranomaly (Cole, 2007). The Prevelance of color blindness varies from region to region

and differs in different geographic areas. for examples, The rate was 6.75% among malea in Baghdad province (Al-musawi, 2014), its was 6.36% among males and 0.84% among female in Shekhan city Duhok province, Kurdistan Region, Iraq (Abdulrahman, 2017), It is was 5.2 % in male and 0.4 % in female at Al – Qadisiyah University(Iraq)(Hamied and Jabar 2018),.It was 8.47% among males and 1.37% among females in Erbil city, Kurdistan Region, Iraq (Simunovic, 2010)(Karim and Saleem, 2013). It was 5.75% in males and 1% in females in Quetta city, Pakistan (Hamida *et al.* 2016). It was 5.85% in males and 0.75% in females in Saudia Arabia (Oriowo and Alotaibi 2008). It was 8.73% in males and 1.69% in females in six populations in Manipur, India (Shah *et al.* 2013), the prevalence was 3.75 % in males and 0.68 % in females to CCVD at Hawassa University, Ethiopia (Mitiku, Tolera, and Tolesa, 2020). People with poor colour vision are at a particular disadvantage with working in professions such as pilots and drivers in technical fields such as medical, engineering and defense professionals (Moudgil, 2016). In addition to this in some fields of studies such aas laboratory, forensic science, chemical engineering, electrical engineering, agriculture, soil engineering and architecture.

MATERIAL AND METHODS

1: Study area

This study was conducted by committees of medical examination in Al- Najaf province especially the driving medical examination committee.

2: Subjects for research and design

A descriptive cross-sectional scan was carried out to determine the colour vision deficiency. Individuals who wanted a medical exam were inclusion criteria, their age between 18-65 years, with normal eye conditions, who gave their consent. In present study, 2470 individuals involved (2158 male, 312 female).

3: Pseudoisochromatic plates (Ishihara test)

One of the best ways to check for colour vision deficiency is pseudoisochromatic plates.

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There are three version of these plates; 38 plates, 24 plates, and 14 plates. In present study, a copy of 24 plates was used, and the copy contains five sets of plates.:

1. Panel 1 is an introductory plate that everyone can read properly.
2. Panels 2-7 are conversion or confusion panels where people with normal vision and persons with defects of colour vision see a different numbers.
3. Panels 8-13 are vanishing plates where regular trichromatic people can read the correct number while colour vision defective people cannot see any number.
4. Panels 14 and 15 are hidden number plates where only visible colour defect can read numbers.
5. Rating plates 16 and 17 are designed to distinguish between red and green colour blindness (Miyahara, 2008). It was put plates on the colour vision test after 75 cm from the subject at the right angles to the line of sight.

4: Genetic data analysis

The CVD phenotypes were recorded for all participants and then allele frequencies were calculated depending on Hardy-Weinberg's law ($p^2 + 2pq + q^2 = 1$) using the gene count method. (Shah *et al.* 2013)(Mitiku, Tolera, and Tolesa, 2020). The level of heterozygosity was calculated by using :

$$\text{Hetrozygosity} = 1 - \sum H_0$$

Where H_0 is the homozygosity of the allele, $H_0 = \sum p_i^2$

5: Allele frequency analysis

Supposing that the population is not of the same ancestor, the frequencies of the normal allele (p), deutan allele (q), protan allele (s). The allele frequency is expected in the female account using allele frequencies for males infected but has been reported to the actual allele frequencies for females based on the infected female.

RESULT

1: Phenotypic frequency of colour vision deficiency

We took in this study about 2470 study subjects which 2158 (87.37%) were male and

312 (12.63%) were female. The age of the participants ranged from 18 - 68 years. 107 had CVD that including 105 males and 2 females. The prevalence of CVD in male was 4.87% and in female was 0.64% (see table 1).

Table (1): Colour vision deficiency (CVD) prevalence by gender

Combined			Male			Female		
Normal (%)	Color blind (%)	Total (n)	Normal (%)	Colour blind (%)	Total (n)	Normal (%)	Colour blind (%)	Total (n)
2363(95.67)	107(4.33)	2470	2053(95.13)	105(4.87)	2158	310(99.36)	2(0.64)	312

In the current study, the number of males affected with deutan was highest among the population in Al- Najaf province 67 (3.10%) and protan was 33 (1.53%), where deuteranomaly was 37 (1.71%) deuteranopia was 30(1.39 %) protanomaly 23 (1.07%), protanopia was 10(0.46 %) and Achromacy 5(0.23%). On the contrary, In female deuteranomaly was 1(0.32%), deuteranopia was 1 (0.32%) but we did not found the other phenotypes (see table 2).

Table (2): Male and female phenotypic frequency of achromacy and various types of CVD

Sex	N	Achromacy	Deutan		Protan	
			Deuteranopia	Deuteranomaly	Protanopia	Protanomaly
Male	2158	5(0.23)	30(1.39)	37(1.71)	10(0.46)	23(1.07)
Female	312	0(0.00)	1(0.32)	1(0.32)	0(0.00)	0(0.00)

2: Allelic and genotypic frequency of colour vision deficiency

If the males are hemizygous (i.e. only one X chromosome), the allele frequency in males in CVD would be the same for the blindness of colour (0.048), while the frequency of the observed (actual) allele in females was to CVD (0.006). Depending upon the allele frequencies of CVD in males, the predicted allele frequencies of CVD in females were $(0.048^2 = 0.0023)$. The heterozygotes were (8.6%), see Table (3).

Table (3) the allelic frequencies of normal, heterozygote, double heterozygote and colour blindness (male and female subjects)

Gender								
Male				Female				
Normal	Deutan	Protan	Total (n)	Deutan	Protan	Heterozygote	Double heterozygote	Colour blind
2053	67	33	2153	$q^2=0.001$	$s^2=0.0002$	$2(pq+ps)=0.086$	$2qs=0.001$	$q^2+s^2=0.0012$
$P=0.955$				$q=0.03$				
				$s=0.015$				

3: Relative parents

From the 107 affected there were 66 (61.7%) having relative parents whereas 41 (38.3%) did not have relative parents see table (4).

Table (4): Clarify relative parents among affected colour blindness

Relative Parents	Yes %	No %	N %
	66(61.7)	41(38.3)	107(100)

4: The relationship of CVD to habitat

From the 107 affected, there are 73(68.25%) live in the centre of the province and the other 34 (31.75 %) live in the peripheral of the province see figure (1).

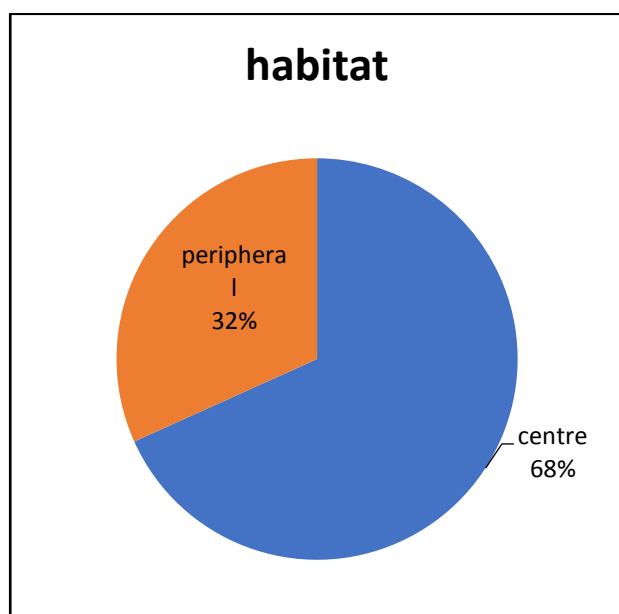


Figure (1): Clarify the rate affected by habitat.

DISCUSSION

The overall prevalence of CVD was lower compared to the recorded in Baghdad(Iraq) between adults males 6.75 % (Al-musawi 2014), furthermore, It was less than recorded in Duhok province, Iraq that was 6.36 % in males and 0.84 % in females (Abdulrahman, 2017), also it was lower from Erbil province, Iraq was 8.47% among males and 1.37% among females (Karim and Saleem, 2013), the proportion was lower from the Quetta city, Pakistan where it was 5.75% in males and 1% in females (Hamida et al. 2016), the ratio of CCVD less

than in Saudia Arabia that it was 5.85 % in males and 0.75 % in females (Oriowo and Alotaibi, 2008), the proportion of CCVD was less then Manipur, India which it was 8.73% in males and 1.69% in females (Shah *et al.* 2013), but the ratio was approximately equal to these in Al-Qadisiyah University, Iraq (Hamied and Jabar, 2018), and the ratio was more than in Hawasaa University Ethiopia (Mitiku, Tolera, and Tolesa, 2020), furthermore, the rate in the present study was higher from the south africa in Durban among school children which it was 4.2% in males and 0.6% in females (Mashige and Staden, 2019). It is very important to examine all the school children colour blindness and chose their career later on wisely. we conclude from this study, the rate of prevalence colour vision deficiency was 4.33 % , while the rate in males was 4.87% and less in the females was 0.64 %.where deutan was more than protan, The ratio of deutan:protan was 2.03:1. There is a relationship between the distribution of CVD and relative parents, we were observed the increasing rate of this disease between them. Also, we noted that the rate of CVD was higher in the male because he has only one X-chromosome, whereas the female has two X chromosome so it can be a carrier or affected. Prevalence CVD was no relationship by habitat. We are recommended that is a benefit to a conducted early exam of colour blindness to the school children to direct them for their own future jobs.

CONCLUSION

This study conducted to find out the prevalence of colour blindness in Al-Najaf province.

In the present study, Among those was screened for colour deficiency, 107 of them(4.33%)were diagnosed with colour blindness, the rate was a difference among gender 105(4.87 %) in male and it was 2(0.64) % in female.

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Ethical clearance

We take approved from all participants before conducting the examination, This study has

passed of the ethical committee in the science college University of Kufa.

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