Prevalence of Congenital Colour Vision Deficiency in Nigerians Living in Ugep, Cross River State.

Abstract:

Colour vision deficiency and colour vision blindness are synonymous terms describing poor colour discrimination by the visual senses. Nowadays, screenings for these disorders are an established practice, so that those affected can be advised about occupational preclusions. Since population based study on the broader impact of colour vision defects is limited, this study was undertaken in Ugep, a rural community in cross river state of Nigeria. Using the cluster sampling technique, a convenient sample of 1500 males and females (of between 10-60 years) were selected. Plates 1-17 of the 2008 edition of the Ishihara's colour album were then administered to the subjects in rooms brightly illuminated by day light. Subjects were then screened with Plates 1, 3, 5, 13 and 15. Study reveals that, the prevalence of congenital colour vision deficiency in Nigerians living in Ugep is 1.8% (28 of every 1500 subjects), while that of total colour blindness was barely 0.2%. Gender distribution of colour blindness appeared in about 2.8% of sampled male subjects, and 0.7% of sampled female subjects, indicating a significantly greater frequency in males than the females. Distribution of colour blindness by age revealed no sequence between age and the defect as $p < 0.001$, df=1. Population based screening for colour vision deficiency is recommended for helpful prevocational counselling.

Keywords: Colour, Blindness, vision, defect, deficiency, senses, visual

1. INTRODUCTION

Colour identification is one of the most important visual abilities and nearly everyone including colour vision defective individuals can see colour and make discriminations based on colour[1]. This general tendency seems to query the rationale for screening colour vision and minimizes the benefits derived from available reports on colour blindness[2 & 3].

Colour vision deficiency is the inability to distinguish certain shades of colour or in more severe cases, see colours at all. The term "colour blindness" is also used to describe this visual condition, but very few people are completely colour blind[4, 5 and 6.] Though most people with colour vision deficiency can see colours, but they have difficulty differentiating between particular shades of reds and greens (most common) or blues and yellows (less common). Colour deficiency is usually inherited and affects up to 8% of males and less than 1% of females[7]. The severity of colour vision deficiency can range from mild to severe depending

on the cause. It will affect both eyes if it is inherited and usually just one if the cause for the deficiency is injury or illness[8 & 9]. Acquired colour deficiency can result from certain diseases, trauma or as a side effect of certain medications.Colour vision is possible due to photoreceptors in the retina of the eye known as cones. These cones have light sensitive pigments that enable us to recognize colour[10]. Found in the macula, the central portion of the retina, each cone is sensitive to either red, green or blue light, which the cones recognize based upon light wavelengths. Normally, the pigments inside the cones register differing colours and send that information through the optic nerve to the brain enabling you to distinguish countless shades of colour[11]. But if the cones lack one or more light sensitive pigments, you will be unable to see one or more of the three primary colours thereby causing a deficiency in your colour perception[11 & 12].

In the course of studying normal colour vision, investigation have observed a wide range of colour discrimination ability especially under such circumstances as the absence of cues, poor illumination, working at speed and viewing objects that subtend a narrow angle at the eye[13]. It is further observed that colour vision defectives show colour vision deficits when compared with those with normal colour vision[1, 13, 14 and 15]. However, some claim that colour vision deficiency does not interfere with daily routine or lifestyle since a reduced visual acuity is not associated with it. Most people with colour vision defects develop effective adaptive strategies and behaviours, and they use other cues such as colour saturation to deal with any potential limitations in their professional personal life[16].

Ishihara (2008) identified colour vision deficiency of congenital origin as the commonest form of colour vision disturbances and explained that most cases of congenital colour vision deficiency are characterized by a red-green deficiency which may be red colour blindness (protein defect).

1.1 Aim of Study

This study aimed at accessing the status of visual perception of colour amongst individuals in the study area. Specifically, the study attempted to:

i. Verify the claim that total colour blindness is a rare condition
ii. Examine the occurrence of colour vision deficiency in the area, based on gender and age

2. METHODOLOGY

2.1 Research design

Descriptive cross-sectional survey was conducted to determine the prevalence of congenital colour vision deficiency in Nigerians living in Ugep, Cross River State.

2.2Study Area

Ugep is an urban settlement in central Cross River State, Nigeria, with a projected population of about 100,000. It has boundaries in the North with Ekori, in the south with Idomi and Adim, in the east with Mkpani and in the west with Ediba and Usumutong communities. There are diverse natural heritage in the area, but majority of the people engage in subsistence agriculture.

2.3The Sample

1500 subjects were selected from the population in the study area.The decision to sample at least, 1500 participants was informed by the 2004 statistical relation fromBill Godden (Lord, 2010), which returned 384 as the minimum sample size for a survey on an area with population as 202,712, that of the study area. This relation is given by:

$$SS = \frac{Z^2 P \times (1 - P)}{C^2}$$

Where →

SS = Sample Size

Z = confidence level as z-score (95% = 1.96 from z-table)

P = Population proportion variance. (Maximal at 0.5 from binomial distribution table)

C = Confidence interval or margin of error (0.05).

2.4Sampling Technique

Using the random sampling technique, the population was considered in clusters of homogenous units such as families, classes (for schools), offices (for employees), church congregations, as well as social and business gathering.

2.5 Instrument for data collection

Plates 1-17 of the 2008 edition of the Ishihara's colour album were used. The individual plates/charts had symbols that were composed of numerous disks of varying colours and brightness.

2.6 Ethical Considerations

A written informed consent was obtained from the study subjects

2.7Procedure

Plates 1-17 of the 2008 edition of the Ishihara's colour album were administered to subjects in rooms brightly lit by daylight. Subjects were then screened with plates 1,3,5,13, and 15. Those judged according to the Ishihara's criteria to be possible colour defect were retested with the full set of plates (Plates 1-15). If the defect was ascertained, then Plates 16 and 17 were used to determine the type of red-green defect. Of the Plates 1-15, if 13 or more plates were read correctly, the colour vision was regarded as normal. If only 9 or less than 9 plates were read normally, the colour vision was regarded as red-green deficient and thus classified as colour blind. Amongst the colour blind individuals, those who read not more than two plates (Plate 1 inclusive) as either normal or red-green were classified as totally colour blind (monochromats), while the red-green defectives (dichromats) were further classified as deutans or protans, based on their ability to read plates correctly.

Subjects were then tested 2 or 3 at a time, standing about 50cm apart and about 75cm from Plates, which were held so that there was no glare. Subjects were given 3 or 4 seconds to read and write the number seen in a plate. The writing was done in a proforma, prepared to facilitate the collection of data

2.8Statistical Analysis

Using SPSS version 15, Evaluation of collected data for statistical significance with chi-squarewas made.P-values less than 0.05 were taken to be statistically significant.

3. RESULTS

We present results in tabular form:

3.1.Frequency of colour vision deficiency

Table 1: Prevalence of Normal/defective colour vision

No. Tested	Normal Colour Vision	Defective Colour Vision
1500	1472 (98.13%)	28(1.87%)

Values are expressed in simple percentage for sampled groups

Table 2.chi square analysis of data on prevalence of Normal/defective colour vision

Colour Vision	Frequency Observed	Frequency expected	df	X^2 cal	X^2 table	P
Normal	**1472**	**750**	**1**	**1390**	**10.827**	**0.001**
Defective	**28**	**750**				

3.2. Frequency of different types of colour vision defect

Table 3. Frequency of various types of colour vision defects detected in samples

No. tested	No of defects					
	Dichromats				Monochromats	Total defects
	Classified		*Unclassified	Total		
	Deutans	Protans				
1,500	16	8	1	25	3	28

**Plates 16 and 17 could not classify this as Deytan or protran*

Table 4. Chi square test statistics on the frequencies of types of colour vision defects

Defect	Frequency Observed	Frequency expected	df	X^2 cal	X^2 table	P
Dichromats	**25**	**14**	**1**	**17.28**	**10.827**	**0.001**
Monochromats	**3**	**14**				

3.3. Frequency of Colour Vision Deficiency base on gender

Table 5: Gender-Specific Prevalence of Colour Vision Deficiency

Gender	No. tested	Defective Colour Vision		Total
		Dichromats	Monochromats	
Male	**830**	**20**	**3**	**23 of 830 (2.8%)**
Female	**670**	**5**	**0**	**5 of 670 (0.7%)**

Table 6: Chi square test statistics on Gender-Specific Prevalence of Colour Vision Deficiency

Gender	Frequency Observed	Frequency expected	df	X^2 cal	X^2 table	P
Male	**23**	**14**	**1**	**8.298**	**6.635**	**0.001**
Female	**5**	**14**				

3.4. Frequency of colour vision deficiency by age

Table 7: Age-specific prevalence of Colour Vision deficiency

Age group (in years)	No. tested	Defective Colour Vision
10-20	682	16
21-30	227	2
31-40	188	1
41-50	395	9
51-60	8	0

4. DISCUSSION

As shown in table 1, the prevalence of colour vision deficiency in this study was 1.87% (28 of 1500 subjects). Roberts (1967) had observed in separate studies frequencies of 1.81% in northern Nigeria, 3.33% in southwest, and 2.11% in the Niger Delta. Comparison of each of these Nigerian samples with a frequency of 1.87% in the present study showed that there was no significant difference in the prevalence of congenital colour blindness among Nigerian populations in spite of the differences in habitat between the northern and southern regions.Odeigah and okon (1986) in a study of separate ethnic groups in Nigeria concluded that the frequency of colour blindness cannot be accounted for on the basis of ethnic composition of samples. On the contrary, Choudhury (1994) found the people of North east india to be extremely variable with regard to this trait, the frequency ranging from 0 to 8.05%; this generates questions on the factors leading to variations in colour blindness among different populations.

Referring to the literature of frequencies of other African populations, Asian and American data as well as the 8% prevalence rate consistently detected for males of European descent, there is sufficient indication that the prevalence of colour blindness among black Africans and Negros generally tend to be low compared to Caucasians. A wide cross sectional repeat prevalence survey as suggested by Natu (1987) might be needed to test the influence of habitat and occupation on colour blindness, especially for studies carried out in rural areas where the uncertainties of ancestry can be minimized.

The prevalence of total colour blindness detected in the present study is 0.20%. this is not significantly different from 0.08% detected by Odeigah and okon (1986) and 0.19% by Williams et al (1998). The prevalence of monochromats in the population is almost negligible and verifies the claim that "monochromacy is rare autosomal trait[17 & 18]". The barely few monochromats detected has made it impossible to state whether there is a significant difference between male and female frequency of total colour blindness. On the other hand, there was a marked discrepancy between male and female dichromats in the data. This high occurrence of the condition in males suggests that the prevalence of colour vision deficiency in the population is gender specific. William *et al* reporteda similar disparity of 3.6% prevalence for males and 0.81% for females, and suggested that these values be regarded as the frequency of colour blindness among Nigerians, especially Yorubas in Lagos.

5.CONCLUSION

Findings from this study are inconsistent with Nigerian samples reported for other regions in the country, suggesting a regional variation of the trait in different population in Nigeria in spite of the difference in habitat between northern and southern regions

Recommendations

It is recommended that;

i. the study on colour blindness be extended to other geopolitical regions in Nigeria in order to ascertain regional variations in colour blindness and determine the factors implicated for such variation.

ii. Population-based screening of colour vision deficiency will be helpful for prevocational counselling.

iii. Teachers are trained to perform colour vision screening and modify their teaching methods to accommodate the child with colour vision deficiency.

iv. Test for normal colour vision be part of medicinal certification that is pre-requisite for obtaining drivers' licenses.

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