

PREVALENCE OF COLOR BLINDNESS AMONG UNIVERSITY STUDENTS SOUTHEAST NIGERIA

Cornelius Nwozor^{1*}, Goodness Eze¹, Chelsea Ngige¹, Calista Ikwuegbu¹, Anita Boniface¹, Kosisochukwu Ifemenam², Henry Enwelum², Chiemelia Anisiobi³ and Evarista Chima-iwuoha⁴

¹Department of Physiology, Faculty of Basic Medical Sciences, Chukwuemeka Odumegwu Ojukwu University, Uli Campus, Anambra State, Nigeria.

²Department of Obstetrics and Gynecology, Faculty of Clinical Medicine, Chukwuemeka Odumegwu Ojukwu University Teaching Hospital, Amaku, Awka, Anambra State, Nigeria.

³Department of Emergency Medicine, Faculty of Clinical Medicine, Royal Devon University Healthcare NHS Foundation Trust (Royal Devon and Exeter Hospital) Exeter, England, EX25DW United Kingdom.

⁴Department of Pediatrics, Ragahid Children Hospital and Maternity, 9/11 Ndikelionwu street, off Port-Harcourt –Aba Expressway, River State, Nigeria.



*Corresponding Author: Dr. Cornelius Nwozor

Department of Physiology, Faculty of Basic Medical Sciences, Chukwuemeka Odumegwu Ojukwu University, Uli campus, Anambra State, Nigeria.

Article Received on 03/07/2024

Article Revised on 23/07/2024

Article Accepted on 13/08/2024

ABSTRACT

Colour blindness, also known as colour vision deficiency, is characterized by the inability to perceive different colours clearly. The career choices of colour-blind people may be limited for safety reasons. The aim of this study was to identify the prevalence of colour blindness among undergraduates in Chukwuemeka Odumegwu Ojukwu University, Uli campus, Uli, Nigeria. A cross-sectional study was conducted among 300 undergraduates, aged 17-28 years, from May to June 2024. Ocular visual acuity assessment using Snellen's chart and a colour vision test with Ishihara plates were used. The data collected were analysed. The results revealed that the overall prevalence of the colour vision deficiency was 7.6% with the males having 4.3% while the females had 3.3%. Screening enables the students affected to become aware of limitations and devise ways of overcoming them.

KEYWORDS:- Color blindness, Males, Females, Undergraduate Students, Prevalence.

INTRODUCTION

Colour blindness or colour vision deficiency is an inability or decreased ability of the perception of colour differences in a physiologic state. Colour blindness is among the commonest pathologies of vision. Congenital and acquired are two types of this condition.^[1,2] Other than being the most common X-linked genetic disorder in humans colour vision deficiencies occur more frequently in men, and the person with colour deficiency may be deficient of one or more pigments. The most common colour vision deficiency is the Red-green colour vision deficiency.^[3,4] Blue-yellow vision defects (Also called tritan defects), are the rarest form of colour vision deficiency, known for problems in differentiating shades of blue and green and cause difficulty distinguishing dark blue from black.^[5]

Acquired colour blindness refers to a defect occurring at any point along the visual pathway.^[4] According to research, prevalence of colour vision deficiencies varies from 1.6% to 13.99% across the globe.^[6,7] The variations

may be likened to precision of the survey, population criteria as well as marriage restriction involving couple who share common ancestry due to religious belief or geographical isolation.^[3]

Colour perception is the ability to distinguish among various wavelengths of light waves and to perceive the differences. The normal human eye can discriminate among hundreds of such bands of wavelength as received by the colour sensing cells (Cones) of the retina. Studies have revealed that the prevalence of colour blindness can vary by age and gender with males having more likelihood to experience colour blindness than females.^[5] Colour blindness may affect academic performance in certain subjects such as arts and design that rely on accurate colour perception. Students with colour blindness may have difficulty identifying colours in laboratory experiments or interpreting colour codes or charts.^[5]

This pathological state may also affect career choices and school performances, particularly in occupations that require colour discrimination such as medicine, design, etc. Visual problem is an important factor that could pose a serious challenge to educational activities in the school. Hence, good vision is required to achieve optimum results in the learning process. Colour is a visual enhancement element that is important in enriching the learning process.^[8]

In terms of risk factors, the major ones for colour blindness include positive family history of colour visual defect, male sex.^[9,10] and consanguineous marriage.^[9] However, sex and positive family history are non-modifiable risk factors for colour blindness. This necessitates the need for genetic counselling for those who have a positive family history, with special focus on those in consanguineous marriage.^[11]

This study aimed to identify the prevalence as well as factors associated with the colour blindness among undergraduates in Chukwuemeka Odumegwu Ojukwu University (COOU), Uli campus, Anambra State, Nigeria.

METHODOLOGY

Research design

A cross sectional study was carried out to determine the prevalence of colour blindness among undergraduates of Chukwuemeka Odumegwu Ojukwu University, Uli campus in May 2024.

Study area

Chukwuemeka Odumegwu Ojukwu University (COOU), Uli campus is located in Uli, Anambra state, Nigeria with a population of over 10,000 students.

Sample Size and Selection

Sample size

Three hundred (300) students were randomly selected from the population of the study area.

Sample population

Simple random sampling technique was used to select eight (8) departments from a total of 21 departments in the university. Students were selected from each department chosen using stratified multistage cluster random sampling.

Instruments used for data collection

Snellen's chart, Ishihara plates, a notebook for collection of data, measuring tape

Inclusion criteria

- Male and female undergraduate students enrolled at COOU, Uli campus.
- Students studying in the eight departments chosen for the sample selection.
- Students who provided informed consent to participate in the study.

Exclusion criteria

- Graduate students, faculty & staff members of Chukwuemeka Odumegwu Ojukwu University, Uli campus. Students not currently enrolled at COOU, Uli campus.
- Students with any medical condition that may impact/affect colour vision (i.e. cataract, glaucoma, etc.)

Ethical consideration

Ethical approval to carry out this study was obtained from Ethical Committee of the Faculty of Basic Medical Sciences, COOU. Only identification number was used in order to preserve the anonymity of student's responses and results.

Procedure

A notebook was used as part of an instrument for data collection of student's data on their age, gender, department, visual acuity and colour perception. The procedures for visual acuity and colour vision test were explained to each student prior to the examination.

Assessment of visual acuity was performed at a place with good daylight (natural) illumination using the standard Snellen's chart at a well-measured distance of 6 m. All students who had medicated glasses had their visual acuity assessed while wearing glasses and without the glasses. Colour vision test was done as described by.¹² The test was done in natural daylight with the plates held at arm's length of the individual. The students were asked to read the numerals seen on each plate within 3 seconds before moving to the next. Students that failed three or more were considered colour blind.

RESULTS

General characteristics of study population

Three hundred students participated in the study consisting of 128 males and 172 females. From figure 1 below showing the prevalence of colour blindness, 13 males (4.3 %) and 10 females (3.3%) have colour blindness. The total number of students that have colour blindness was 23 (7.6%) while 277 (92.3%) of students did not have colour blindness. Few of the students from the study population were aware of the term "Colour Blindness". Only two students, a male and a female knew they had difficulties seeing colours.

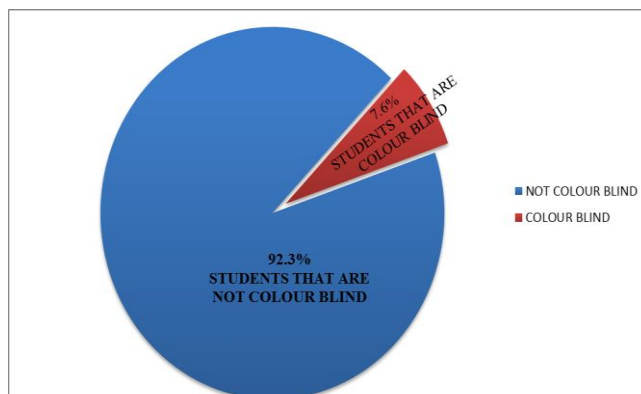


Figure 1: Pie chart showing prevalence of colour blindness.

Table 1: Age group.

Age range	Frequency	Percentage (%)
17-20	148	49.3
21-23	110	36.7
24-26	34	11.3
27-29	8	2.7

Table 2: Department.

Department	Frequency	Percentage (%)
Engineering	56	18.6
Biochemistry	55	18.3
Microbiology	54	18
Physiology	53	17.6
Anatomy	33	11
Industrial chemistry	21	7
Computer science	15	5
Biological sciences	13	4.3

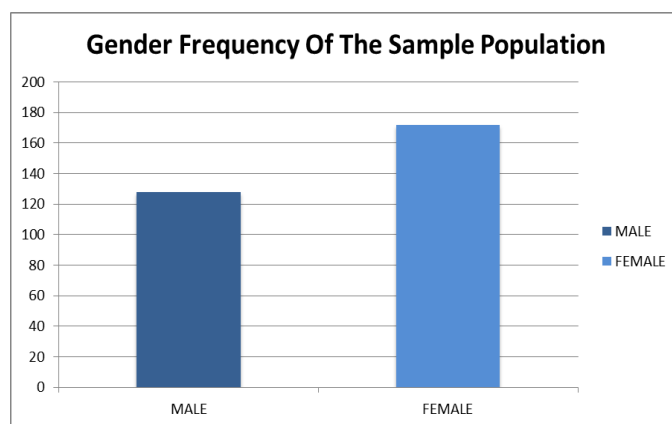


Figure 2: Gender distribution.

Total sample population: 300; female population 172; male population 128.

Intensity of colour blindness identified

The total number of students with colour blindness was 23 (7.6%), 7 (2.3%) students have a mild intensity of colour blindness, 13 (4.3%) students have moderate colour blindness and 3 (1%) have a severe intensity of colour blindness. This is illustrated below:

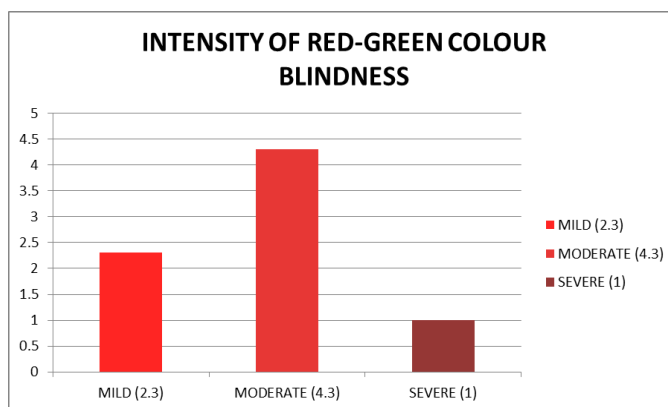


Figure 3: Intensity of Red-Green colour blindness.

Relationship between colour Blindness and Field of study

Eight (8) departments from a total of 21 departments in the university were chosen to get the total sample

population of 300 students. Below is an illustration of the departments and the number of colour-blind students from each department.

Table 3: Distribution of colour blindness by field of study (Department).

Department	Frequency	Percentage (%)
Engineering	6	26.1
Biochemistry	5	21.7
Microbiology	3	13
Industrial Chemistry	2	8.7
Computer Science	2	8.7
Physiology	3	13
Anatomy	1	4.4
Biological Sciences	1	4.4
Total	N=23	100

Table 4: Visual acuity result of the sample population.

Visual Acuity	Right eye N (%)		Total Percentage (%)	Left Eye N (%)		Total Percentage (%)
	Male	Female		Male	Female	
20/5	19 (6.3)	19 (6.3)	12.6	18 (6.0)	21 (7.0)	13.0
20/6	12 (4.0)	27 (9.0)	13.0	11 (3.6)	30 (10.0)	13.6
20/9	19 (6.3)	32 (10.6)	16.9	28 (9.3)	32 (10.6)	19.9
20/12	5 (1.6)	4 (1.3)	2.9	5 (1.6)	5 (1.6)	3.2
20/18	5 (1.6)	16 (5.3)	6.9	4 (1.3)	17 (5.6)	6.9
20/20 (normal vision)	65(21.6)	70 (23.3)	44.9	58 (19.3)	66 (22)	41.3
20/24	2(0.6)	0(0)	0.6	2 (0.6)	1 (0.3)	0.9

DISCUSSION

Colour blindness as a congenital vision defect can greatly affect quality of life and career choice of a person. This study examined the prevalence of colour vision deficiency among undergraduate students of Chukwuemeka Odumegwu Ojukwu University (COOU). The results showed that only 23 students (7.6%) out of a population of 300 were colour blind. The male population had a prevalence of 4.3% while the female population had 3.3%. The prevalence was higher in males than females. This is in agreement with^[8] who reported higher prevalence in males than females.

Already various studies have been done about colour blindness prevalence given its importance especially to the academic training environment such as universities. In Egypt, for instance a large-scale study was carried out on the prevalence of colour vision defect. The study was among 267 student volunteers in Menofia University Campus and found that the prevalence of red-green colour visual defect was 8.75%.^[4] Referring to studies conducted in other African countries, ^[12] reported congenital colour blindness prevalence of 4.2% in Southern Ethiopia. Furthermore^[13] and^[14] reported prevalence of 2.2% and 3.57% in Libya and Zulus decent respectively.

Among the 23 colour blind students only 2 students, a male and a female were aware of having colour blindness. 30 of the respondents consisting of 11 males and 19 females indicated they have known vision defects like myopia while the rest claimed to have normal visual acuity.

The visual acuity assessments of the respondents showed that the percentage of the students with normal visual acuity (20/20) was higher with 44.9% for the right eye and 41.3% for the left eye. Some students had severe visual acuity ranging from (20/18-20/24) with 7.5% for the right eye and 7.8% for the left eye. Therefore, majority of the students including the colour blinds have normal visual acuity.

The prevalence of colour blindness defect as detected in this study was 7.6% (23 of 300 students) which was higher compared to figures in previous studies in Nigeria such as 1.7% in Awka, Anambra state,^[8] 2.5% in Lagos.^[15] While prevalence of 2.6% and 1.6% were reported in Southern and Northern parts of Nigeria by^[16] and^[17] respectively. Comparison of prevalence of colour blindness in other studies with 7.6% in present study showed that there was a significant difference in the prevalence among Nigerian populace.

The high prevalence of 7.6% in comparison to other Nigerian & African studies may be due to the following factors: sample population (300) which was higher than that of,^[8] eight departments were included in this present research, which was in contrast to that of^[8] study that used only medical students. This present study used the age range of (17-28yrs) in contrast to^[16] (5-11yrs),^[17] (5-12yrs),^[18] (13-18yrs). Regional genetic factors and sampling methods used in the present study and their studies may also contribute to the discrepancy. The location can also affect the results obtained. Whereas the present study took place at Uli other studies locations were mainly state capitals: Awka, Lagos, and Ibadan. The higher prevalence rate in this study suggests that targeted public health intervention & colour blindness awareness is necessary in the region.

Students with poor visual acuity and vision defect usually develop learning difficulties that can have long-term effects on their academic success and future career opportunities, social life, educational outcomes. This vision defects can affect an individual for life leading to major problems in terms of searching for a job, it can lead to reduced job opportunities, lower salaries, decreased job satisfaction, limited career choices. It makes the individual prone to increased safety risk for instance, a driver with vision defect could fail to see a hazard on the road and a pilot with impaired sight might misinterpret critical signs. It also causes reduced productivity i.e. an electrician with impaired vision can risk incorrect wiring, leading to potentially severe consequences.

CONCLUSION

In some professions, proper colour recognition is essential and early detection of colour blindness is useful to avoid occupational hazards. This study shows the prevalence of colour blindness (7.6%) among undergraduates, raising awareness in the affected to enable them make necessary adjustments. This, therefore, can be considered a rare defect not many people know about. More awareness is advised to enable more people to know about it and make necessary changes.

REFERENCES

1. Simunovic MP Colour vision deficiency. *Eye*, May, 2010; 24(5): 747–55. <http://dx.doi.org/10.1038/eye.2009.251> PMID: 19927164.
2. Fareed M, Anwar MA, Afzal M Prevalence and gene frequency of colour vision impairments among children of six populations from North Indian region. *Genes Dis*. Jun, 2015; 2(2): 211–8. <https://doi.org/10.1016/j.gendis.2015.02.006>.
3. Birch J Worldwide prevalence of red-green color deficiency. *J Opt Soc Am A Opt Image Sci Vis*. Mar, 2012; 1, 29(3): 313–20. <http://dx.doi.org/10.1364/JOSAA.29.000313> PMID: 2247276
4. Marey HM, Semary NA, Mandour SS Ishihara electronic colour blindness test: An evaluation study. *Ophthalmol Res Int J*. Dec, 2015; 16, 3(3): 67–75. <https://doi.org/10.9734/OR/2015/13618>.
5. Nurlelawati JA, Rodzyah YM, Normahdiah SS Students' colour perception and preference: an empirical analysis of its relationship. *Procedia Soc Behav Sci*, 2013; 90: 575-82.
6. Al-Aqtum MT, Al-Qawasmeh MH Prevalence of colour blindness in young Jordanians. *Ophthalmologica*. Jan-Feb, 2001; 215(1): 39–42. <http://dx.doi.org/10.1159/000050824> PMID: 111252
7. Hashemi H, Khabazkhoob M, Pakzad R, Yekta A, Heravian J, Nabovati P, et al. The prevalence of color vision deficiency in the northeast of Iran. *J Curr Ophthalmol*. Mar, 2019; 31(1): 80–5 <http://dx.doi.org/10.1016/j.joco.2017.05.005>.
8. Nwobodo E, Darawuzie N, Ikwuka D Prevalence of Colour Blindness in Nigeria: Nnamdi Azikiwe University Medical Students, 2021. *Cyprus J Med Sci*; DOI: 10.5152/cjms.2021.2216.- Available online at <https://cyprusjmedsci.com/EN>
9. Dahlan HM, Mostafa OA Screening for Color Vision Defects among Male Saudi Secondary School Children in Jizan City, King-dom of Saudi Arabia. *Med J Cairo Univ*, 2013; 81(2): 513–7.
10. Khairoalsindi OA, Almasoudi BM, Bamahfouz AY, Alghamdi AA, Siddiqui MI Prevalence and determinants of color vision defects among preparatory university students at Makkah, Saudi Arabia. *Middle East Afr J Ophthalmol*, 2019; 30, 26(3): 133–7. http://dx.doi.org/10.4103/meajo.MEAJO_29_19 PMID:3161989

11. Osman S, Khalaf S., Mohammed H. and Elsebaity D. Prevalence and predictors of colour vision defects among Egyptian university students. *Eastern Mediterranean health journal*, 2021; 27(4): 399-406.
12. Woldeamanuel GG, Geta TG Prevalence of color vision deficiency among school children in Wolkite, Southern Ethiopia. *BMC Res Notes*, 2018; 11(1): 838.
13. Rahman SA, Singh PN, Nanda PK Comparison of the incidence of colour blindness between sections of Libyan and Indian populations. *Indian J Physiol Pharmacol*, 1998; 42(2): 271-5.
14. Pickford RW, Pickford R Frequency of colour vision defects among Zulus in Natal. *J Biosoc Sci*, 1981; 13(2): 241-8.
15. Oduntan OA, Mashige KP, Kio FE Colour vision deficiency among students in Lagos State, Nigeria. *Afr Health Sci*, 2019; 19(2): 2230-6.
16. Tabansi PN, Anochie IC, Nkanginieme KE, Pedro-Egbe CN Screening for congenital color vision deficiency in primary children in Port Harcourt City; teachers' knowledge and performance. *Niger J Med*, 2008; 17(4): 428-32.
17. Abah ER, Oladigbolu KK, Samaila E, Gani-Ikilama A Ocular disorders in children in Zaria children's school. *Niger J Clin Pract*, 2011; 14(4): 473-6.
18. Ugalahi MO, Fasina O, Ogun OA, Ajayi BG Prevalence of congenital colour vision deficiency among secondary school students in Ibadan, South-West Nigeria. *Niger Postgrad Med J*, 2016; 23(2): 93-6.