A SURVEY OF HEREDITARY COLOUR VISION DEFECT IN GHANAIAN STUDENTS

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SUMMARY
The colour vision of 2,524 Ghanaian students made up of 1296 female and 1228 males were assessed in a cross-sectional survey. Eighty-seven students had hereditary colour vision defects. Red-Green defect accounted for 83 out of 87 of the colour blindness detected made up of 74/1228 (6.02%) of the male and 9/1296 (0.69%) of the female population.

The prevalence of red-green colour blindness is significantly higher in males than females. We think it will be helpful and worth screening male students for colour vision defects to create awareness among parents, students and teachers and guide career planning.

Keyword: Colour blindness, colour vision.

INTRODUCTION
Perception of colour is a psychophysical experience that features in many daily experiences and depend on the presence of visual sensors, rods and cones in the retina. Colour vision is only present in bright light (photopic vision) when cones function. It is absent in the dark (scotopic vision) when rods function. The visible part of the electromagnetic spectrum is made up of wavelengths 4-7nm. Normal colour vision is trichromatic. The primary colours of light are blue (short waves), green (medium waves) and red (longwaves). There are 3 populations of cones in the retina with different spectral sensitivity ranges. All colours in the visible spectrum can be matched by differential stimulation of these cones. A normal ability to discriminate the spectral hues is not universal.

Trichromats have all three, dichromats have two, and there is no colour appreciation if there is only one population of cones (monochromats) or no cone (achromats). Such people match with brightness of the object rather than the colour. Congenital or inherited colour defects are genetic disorders usually affecting one type of cone and results in identical colour defect in both eyes. Although it is commonly called colour blindness it usually occurs in people with normal visual acuity and runs a stable course. Acquired defects are usually due to ocular or general disease or side effect of medications. They are usually associated with other abnormal visual features such as reduced visual acuity, visual field defects and may involve one or both eyes.

Many daily activities and jobs depend on normal colour vision. Abnormal appreciation of colour also has occupational consequences. Some people with colour defects are not aware of any problem until their colour is tested during routine medical examination requested by an employer. The objective of this survey was to find out the prevalence of colour blindness in Ghana school children in Accra.

METHODS
This was a cross-sectional study. Two clusters based on mixed ethnicity were chosen in the North-East and South-West of Accra with 10 schools each. By simple random sampling we selected 12 Junior Secondary Schools from these clusters. Consent was obtained from the head teachers of the schools involved. Two head teachers were reluctant to sign a written consent and those schools were dropped leaving ten. The ten consisted of four private and six public schools. A team of 4 including the authors screened all the students present in the class at time of survey with Ishihara colour vision test charts. The principal investigator re-examined all those picked up with colour defects during screening to confirm diagnosis with the "Ishihara's Tests for Colour-Blindness 24 Plates Edition". Other causes of colour of vision defect were ruled out by observing the physical appearance, general eye examination, optic nerve and macular function. The achromats were sent to the Korle Bu Eye Clinic for refraction, slit lamp examination and bimicroscopy. Those with glaucomatous looking optic discs were referred to the Ophthalmologist for further assessment and management. Inclusion criteria were consent from the headteacher and student, Ghanaian nationality. Exclusions criteria were

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non-Ghanaian nationality and existence of other conditions that may affect colour vision. A total of 2,527 students were examined. Two were not eligible for inclusion because of glaucomatous optic disc cupping one for protein-calorie malnutrition.

RESULTS

The remaining 2,524 made up of 1,296 female and 1,228 males were eligible for analysis. The mean age of the children was 14, median 14 and range 12-21years. There was no difference in age between buys and girls. Eighty-seven students had colour defects: 83 red-green defect and 4 atypical achromats. The types and frequency are displayed in Table 2.

Table 1 Age distribution of children

	Count of AGE
Age	**Total**
10	1
11	27
12	257
13	546
14	658
15	531
16	302
17	138
18	55
19	7
20	1
21	1
Grand Total	**2524**

Table 2 Types of colour blindness

Type	Female		Male		Total	
	No	%	No	%	No	%
Red-Green	9	0.69	74	6.02	83	3.29
Protanopia/anomaly	2	0.15	9	0.73	11	0.44
Deutereuro-pia/anomaly	7	0.54	65	5.37	72	2.89
Atypical Achrimats	2	0.15	2	0.16	4	1.16
Total	**11**		**76**		**87**	**3.45**

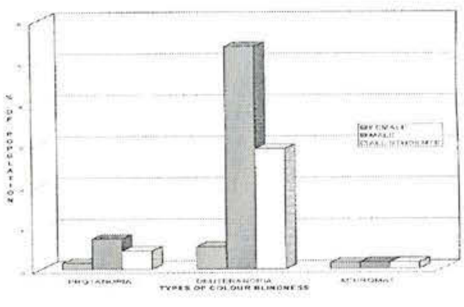

Figure 1 Relative frequencies of types of colour blindness .

Red-green defect which is sex-linked was present in 6.02% of the male and 0.69% of the female population (Figure 1). A comparison of proportions using the chi squared test showed significant gender difference (P value of 6.037×10^{-14}). The 4 atypical achromats formed 0.16% of the total population. There was no gender difference, as this condition is not sex-linked (P value 0.957). Though some of the affected pupils did not know they had a problem some had observed difficulties with seeing some pictures on the television.

DISCUSSION

Colour vision can be tested clinically by several methods, the Ishihara pseudoisochromatic test plates being the most commonly used. It tests red-green deficiency and is thought to be the most reliable from clinical trials[1,2]. People with slight protan and deutan defects read some plates correctly. Red-green colour blindness is the commonest type of colour blindness and it is inherited as X-linked recessive disorder.

Our results confirm the sex linked hereditary pattern. Blue-yellow (tritanomalia) is extremely rare and total colour blindness (achromatopsia) is rare. There is marked racial and regional variation in prevalence of red green colour blindness: 2.0%-8.0% for males and around 0.7 for female.[3,4,5,6,7,8] Caucasian prevalence figures tend to be higher than for Asians and Africans. Our 6% prevalence in males is higher than 2% reported in the Niger Delta where a much smaller sample size of less than 400 was studied.[9] It is within the range of 4-7% for males given for Chinese[6]. Also in both the Chinese and our survey protan defects were less common than deutan in a ratio of 1:3 in Chinese and 1:7 in ours.

The use of colour extends to the work environment so it affects jobs and careers that require colour identification. Those requiring perfect colour vision include those in navigation and civil aviation. Defective colour vision is a handicap and might result in errors of colour judgement. Good colour vision is desirable but if defective will not necessarily cause a handicap in certain professions e.g. dressmakers, florists, interior decorators. On the contrary defective colour vision may be an asset in camouflage detection[9,10].

The symptom often noticed by the affected students was that when watching television colours on the screen sometimes became bizarre but none of them found out the cause of this symptom and were not aware of colour blindness and its implications. We did not quantify this symptom though it would have been interesting but the absence of this information will not affect our objective, the prevalence. Among male students 6 in a 100 as compared with 7 in 1,000 female students were found to have congenital colour vision defect. The prevalence of red-green colour blindness is significantly higher in males than females. We think it will be helpful and worth screening male students for colour vision defects to create awareness among parents, students and teachers and guide career planning. Though females have low prevalence it may be worthwhile screening them when this awareness will prevent serious consequences[11,12].

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