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SHAIK Y. SAHEB, A. PULLA REDDY

INCIDENCE OF RED-GREEN COLOUR BLINDNESS IN INDIAN POPULATIONS

INTRODUCTION

Many studies by geneticists and physical anthropologists has established that red-green colour blindness is a sex-linked character in man, i.e the genes responsible for this trait are located in the X chromosome. Individuals with normal colour vision, who require a particular ratio of red, green and blue colours to perceive white, are known as trichomates; and persons who require one of the primary colours in higher proportion than the other two colours, are known as anomalous trichomates. However, there are some individuals, who require only two of the three primary colours to see white; these are known as dichromates. The most popular kind of dichromate red-green colour blindness has been studied by different authors, among various endogamous population of Andhra Pradesh [Dronamraju and Meera Khan 1961, 1963; Ramachandraiah 1960; Chakravarthy et al. 1971].

The purpose of this paper is to present results of an investigation carried out in April, 1977, on red-green colour blindness in Triupati school children of Andhra Pradesh and compare them with other Indian and world populations.

MATERIAL AND METHOD

The investigations were mostly carried out in the educational institutions of Tirupati, Chittoor District of Andhra Pradesh, with the help of Ishihara's tests for colour blindness (38 plates, edition 1970). Red (protan type) green (deutan type), colour blindness was studied in different endogamous groups of Tirupati population. The individuals were asked to read the plates and in a few doubtful cases, the subjects were asked to trace the lines to express their colour perception. The

total sample consists of 253 individuals, which includes 184 males and 69 females. All the tests were carried out in adequate daylight avoiding direct sunlight. The data on other Indian and world groups used in the present paper for comparisons were taken from the papers listed at the end of this article where relevant information is either originally presented or quoted.

RESULTS AND DISCUSSION

Table 1 shows the incidence of colour vision defect among school children of Tirupati. Among 184 male individuals tested, frequency of colour blindness is 1.63% of protan type and 3.80% of deutan type and among 69 females 1.45% of deutan type while no case of protan type of colour blindness has been observed.

The classification of normals of both sexes is shown in table 2. 54.60% of males out of 184, and 44.12% of females out of 69 were able to read all the plates in a normal way. The number of mistakes committed by males is higher than that of females while testing the abnormal colour vision. The frequency of mistakes decreases in the following order of plates 4, 12, 17, 7, 13, 24, 22, 9 and others. The plates 1, 2, 14, 15 and 25 were read normally by all the males and females.

Table 1. Incidence of colour vision defect among school children of Tirupati

Group	N	Normal		Types of colour blindness			
				Protan		Deutan	
		n	%	*n*	%	*n*	%
Males	184	174	94.57	3	1.63	7	3.80
Females	69	68	98.55	–	0.00	1	1.45

Table 2. Classification of normals

No. of mistakes committed	Males		Females		Total	
	n	%	*n*	%	*n*	%
All plates read normally	95	54.60	30	44.12	125	51.65
One to two mistakes	55	31.61	18	26.47	73	30.17
Three to four mistakes	16	9.19	11	16.18	27	11.16
Five to seven mistakes	8	4.60	9	13.23	17	7.07
Total	174	100.00	68	100.00	242	100.00

Table 3. Frequency distribution of protans and deutans in Andhra Pradesh school children

Group	Tested No.	No. of colour blind (*n*)	Types of colour blindness				Protan: Deutan type ratio
			Protan		Deutan		
			n	%	*n*	%	
School children (Coastal Andhra)	569	34	9	1.55	25	4.33	1 : 2.8
Tribals (Andhra)	1155	28	4	0.35	24	2.07	1 : 6.0
School children (Anantapur)	536	22	5	0.93	17	3.17	1 : 3.4
School children (Visakapatnam)	292	9	4	1.37	5	1.71	8 : 11
School children (E. Godawari)	617	36	7	1.13	29	4.70	1 : 4.17
School children (Tirupati)	184	10	3	1.63	7	3.88	1 : 2.3

Table 3 shows the frequency distribution of protan and deutan types in Andhra Pradesh school children compared with the school children of Hirupati. The frequency of protans and deutans in coastal districts of Andhra Pradesh is lower than in the Tirupati school children but differences among them are statistically insignificant (χ^2 = = 0.0478, d.f. = 1, .90>p>.80). The ratio of protans to deutans differs in individual groups within the same Andhra population. Except the school children of Visakapatnam the other Andhra populations show protan/deutan ratio of about 1 : 3.

When the protan frequency is compared with the deutan frequency, the deutan type shows prevalence over protan type in different populations of Andhra Pradesh and the high occurrence of deutans in various

Table 4. Frequency of colour blindness in some ethnic groups of Andhra Pradesh

Population	Locality	Males		
		N	Colour blind	
			n	*f*
Harijans	Andhra (Pooled)	118	4	.03
Sudras	,,	604	32	.05
Muslim	,,	108	3	.03
School children	Coastal (Andhra)	1721	98	.06
Tribals	,,	1155	29	.03
Hindus	Anantapur	442	22	.05
School children	Chittoor	184	10	.05

populations may suggest some selective force operating in favour of green blindness. Furthermore there is also slight geographical trend from South Andhra Pradesh to North coastal Andhra Pradesh.

The chi-square values calculated for the comparisons of protan--deutan types of colour blindness among the school children of coastal Andhra, Anantapur, Visakapatnam, East Godavari with the present study show insignificant differences ($\chi^2=0.0478$, d.f.$=1$, $.90>p>>.80$; $\chi^2=0.1899$, d.f.$=1$, $.70>p>.50$; $\chi^2=0.4257$, d.f.$=1$, $.50>p>30$; $\chi^2=0.4851$, d.f.$=1$, $.50>p>.30$ respectively) in males. When the protan--deutan types in Andhra tribals are compared to the present study, the chi-square value indicates insignificant difference among the males ($\chi^2=1.1228$, d.f.$=1$, $.30>p>.20$).

Table 5. Frequency of colour blindness in some ethnic groups of Karnataka

Population	Locality	Males		
		N	Colour blind	
			n	*f*
Adi Karnataka	Mysore	540	14	.03
Sudhras	Karnataka	1376	61	.04
Muslims	,,	217	12	06
Hindus	,,	550	32	.06
Brahmins	,,	87	5	.06
School children	Andhra	184	10	.05

Table 6. Frequency of colour blindness in some populations of India

Population	Locality	Males		
		N	Colour blind	
			n	*f*
Marathas	Maharastra	273	7	.03
Muslims	,,	201	9	.04
Brahmins	Bombay	500	22	.04
Orissa	Orissa	504	25	.05
Brahmins	Tamilnadu	500	30	.06
Rajputs	(W.U.P)	591	43	.07
Hindus	Assam	754	28	.04
Jats	Panjab	564	20	.04
Kumaon	(U.P)	537	18	.03
Rana Tharu	Nainital	350	13	.04
Newars	Nepal valley	520	22	.04
School children	Andhra	184	10	.05

Table 4 shows the frequency of colour blindness in some ethnic groups of Andhra Pradesh compared with the school children of Tirupati, Chittoor District. Inter-group comparison shows insignificant differences in the frequency of colour blindness with exception of the tribals of Andhra for which difference is significant (χ^2 4.659, d.f. = 1, $.05 > p > .02$) in males. The frequency of colour blindness in some ethnic groups of Karnataka compared to the present study is shown in table 5. The chi-square values of Adi Karnataka, Sudras, Muslims, Hindus and Brahmins of Karnataka as compared to the present study show insignificant differences among them in the incidence of colour blindness. Thus the differences which are existing in its frequency among the Karnataka population and the present population are statistically insignificant.

Table 6 shows the frequency distribution of colour blindness in some ethnic groups of India compared with the present study. The χ^2 values calculated for inter-group comparison among various endogamous groups of India show insignificant differences with the present study population in the frequency of colour blindness.

Table 7. Inter and intra group comparison among the ethnic groups of India, d. f. = 1

Group	χ^2	p	Results
Tribal X School children (Andhra) (Coastal Andhra)	15.9179	$.001 > p$	Significant
Muslim X Muslim (Karnataka) (Maharashtra)	0.2300	$.70 > p > .50$	Insignificant
Muslim X Muslim (Andhra) (Maharashtra)	0.5227	$.50 > p > .30$	Insignificant
Muslim X Muslim (Andhra) (Karnataka)	1.1838	$.30 > p > .20$	Insignificant
Sudhra X Sudhra (Andhra) (Karnataka)	1.06684	$.50 > p > .30$	Insignificant
Sudhra X Marathas (Marnataka) (Maharashtra)	1.1748	$.30 > p > .20$	Insignificant
Harijan X Adi Karnataka (Andhra) (Mysore)	0.253	$.70 > p > .50$	Insignificant
Sudhra X Adi Karnataka (Andhra) (Mysore)	5.1892	$.05 > p > .02$	Significant
Hindus X Hindus (Anantapur) (Mysore)	0.3183	$.70 > p > .50$	Insignificant
Hindus X Hindus (Anantapur) (Assam)	3.0614	$.10 > p > .05$	Insignificant
Brahmins X Brahmins (Bombay) (Tamil Nadu)	1.2308	$.30 > p > .20$	Insignificant
Brahmins X Brahmins (Tamil Nadu) (Mysore)	0.0079	$.95 > p > .90$	Insignificant
Brahmins X Brahmins (Mysore) (Bombay)	0.2921	$.80 > p > .50$	Insignificant

Table 8. Frequency of colour blindness in the world populations

Population	Males		
	N	Colour blind	
		n	*f*
Mexican population (Mexico)	1162	51	.04
Bantus (Africa)	326	7	.02
Kampala Indians (Africa)	537	10	.02
Ruandau Urundi (Africa)	2000	52	.03
Nigerians (Africa)	609	11	.02
Niger Delta (Africa)	380	8	.02
School children (Andhra)	184	10	.05

The χ^2 values in table 7 for intra- and inter-group comparisons show that school children of coastal Andhra differ significantly from the tribals of Andhra, and Sudras of Andhra from Adi Karnataka of Mysore in the incidence of colour blindness ($\chi^2=15.9179$, d.f.$=1$, $.001<P$; $\chi^2=5.1892$, d.f.$=1$, $.05>p>.02$ respectively), whereas the inter-group comparison among the other ethnic groups shows insignificant differences (table 7).

Frequencies of colour blindness among world populations are shown in table 8. Chi-square values show significant difference of our group with all the African populations and insignificant difference with respect to the Mexican populations.

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Shaik Y. Saheb
Anthropological Survey of India, V. V. Mohalla
Mysore — 570 002, India

A. Pulla Reddy
Research Scholar, S. V. University College, Tirupati,
Andhra Pradesh, India

WYSTĘPOWANIE ŚLEPOTY WZGLĘDEM BARWY CZERWONEJ I ZIELONEJ W POPULACJACH Z INDII

SHAIK Y. SAHEB i A. PULLA REDDY

W szkołach regionu Tirupati (stan Andhra Pradesh) zbadano zdolność rozróżniania barw przy pomocy testu Ishihary [1970] u 253 osobników (84 chłopców i 69 dziewcząt). Stwierdzono, że ślepota na barwę czerwoną (protan) występuje u chłopców z częstością 1,63%, ślepota zaś na barwę zieloną (typ deutan) z częstością 3,80%. U dziewcząt typ deutan wystąpił z częstością 1,45%, nie stwierdzono zaś typu protan.

Proporcja protan/deutan wykazuje niewielkie różnice w różnych grupach z terenu stanu Andhra. Jej wartość wynosi około 1 : 3 we wszystkich zbadanych dotychczas grupach, z wyjątkiem dzieci szkolnych z Visakapatnam. Korzystając z danych z piśmiennictwa autorzy porównali częstość występowania ślepoty barwnej w różnych populacjach z terenu Indii. Test chi-kwadrat wskazuje zasadniczo na brak istotnych różnic międzypopulacyjnych, wyjątek stanowią dwa porównania (por. tabela 7). Porównanie własnych danych autorów z danymi dla ludności różnych kontynentów (tab. 8) wskazuje, że badana grupa z Indii różni się pod względem częstości ślepoty na barwy od populacji z terenu Afryki, natomiast brak istotnej różnicy z ludnością Meksyku.