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***Research Article** (Open Access)*

DISTRIBUTION OF MORPHOLOGICAL, BEHAVIOURAL AND SEROLOGICAL TRAITS AMONG EIGHT ENDOGAMOUS GROUPS BELONGING TO HARYANA

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ABSTRACT
Data are provided on the distribution of morphological traits: ear lobe attachment and colour vision;behavioural traits: hand clasping, arm folding, leg folding and handedness and serological traits: ABO and Rh blood groups among eight endogamous groups of Haryana state viz. Balmiki, Bhat, Chirimar, Mazbi Sikh, Rahbari, Sikligar, Singikat and Sunni Muslim. All the traits showed heterogeneous distribution. The frequencies of morphological and behavioural traits showed slight deviation either in upper maxima or lower minima as compared with the range of other populations of North-West India. There was preponderance of the B allele over the A allele in all the caste groups except in Singikat which showed equal incidence of both the alleles. The distribution of these blood groups was found to be heterogeneous in the populations (χ^2=12.76, d.f.=7, 0.01<p<0.05). The distribution of ABO blood group system was found to be statistically significant in Chirimar (χ^2=10.025, d.f.=3, 0.02<p<0.01). The distribution of Rh(D) blood group system was found to be statistically significant in Mazbi Sikh (χ^2=3.303, d.f.=1, 0.01<p<0.001) and in Singikat (χ^2=8.331, d.f.=1, 0.01<p<0.001). The allele frequencies recorded during the present study fall well within the range for North-West Indian populations.

Keywords: *Ear Lobe, Colour vision, Handedness, ABO- Allele Frequency, Rh(D)- Allele Frequency*

INTRODUCTION
In Haryana, 82 communities have been identified (Singh 1994). Most of these communities are widely distributed. The population genetics studies carried out on these castes are quite scanty (Khurana 1956; Mourant *et al.* 1976; Malik *et al.* 1988; Kushwaha *et al.* 1990a,b; Yadav and Gupta 1992; Yadav *et al.* 1994, 1997a,b,c, 1998, 2000 and 2001; Yadav and Singh 2002; Chhikara and Yadav 2011; Yadav *et al.* 2014; Jain *et al.* 2014; Jaggi and Yadav 2014; Jain 2020 and Jain 2022). The present study has been carried out on the distribution of morphological, behavioural and serological traits among eight endogamous groups of Haryana- Balmiki, Bhat, Chirimar, Mazbi Sikh, Rahbari, Sikligar, Singikat and Sunni Muslim.

MATERIALS AND METHODS
Subjects
The Balmiki community is distributed all over the country. In Haryana they are scattered all over the state and are included in the Scheduled Caste community. The Balmikis earn their livelihood by working in the fields and as labourers, but their traditional occupation is scavenging including removal of night soil. The Bhats are called Rai. They include both landowners and landless. Traditionally they are genealogists who subsist on alms. The Chirimars are also known as Bahelia. Trapping and trading of birds is their traditional occupation. Due to ban on hunting and trapping of wild animals and birds, now they find it difficult to go ahead with their traditional occupation. The Mazbi Sikhs are a Scheduled Caste who has become Sikhs. Most of the Mazbi's are landless. Their main occupation is agricultural labour. The traditional occupation of the Rahbaris is rearing, breeding and selling of camels and transportation of goods on camel carts. Agriculture is their subsidiary occupation. The Sikligars have metal burnishing and

blacksmithy as their traditional occupations. They also make and repair agricultural implements. The main economic resource of the Singikats is sucking of bad-blood accumulated in the paining parts of human body with the help of a horn shaped 'singi'. They claim to cure pain by this method. The Sunni Muslims are scattered in various parts of India. In Haryana state they are mostly in the occupations of washer men, drycleaners and labourers. The data for various traits was collected from 400 subjects in the age group 10-60 years and were randomly sampled from different localities of Haryana state (Table-1).

Methods

The following traits were investigated using standard techniques (Wiener and Lourie 1969):
Morphological traits: ear lobe attachment and colour vision. Behavioural Traits: hand clasping, arm folding, leg folding and handedness. Tests for colour-blindness were made using a series of plates designed as "Test for colour blindness (38 plates edition) by Ishihara" (Ishihara 1960).
A few drops of blood were drawn by finger prick on microscopic glass slides. The blood grouping tests were performed on the spot following instructions of anti-sera manufacturers. The allele frequencies for the ABO system were calculated by the method of Yasuda (1984) while those for the Rh (D) system were estimated by the square root method (Mourant *et al.* 1976).

RESULTS

Ear lobe attachment

The frequency of attached ear lobes ranged from 12% to 78% (Table 1). The highest frequency was found in Bhat and lowest in Sunni Muslim. The inter-caste differences were found to be significant between Balmiki-Bhat (χ^2=5.472, d.f.=1, 0.05<p<0.02), Balmiki-Sunni Muslim (χ^2=21.568, d.f.=1, 0.001<p), Bhat-Mazbi Sikh (χ^2=13.5, d.f.=1, 0.001<p), Bhat-Sikligar (χ^2=4.595, d.f.=1, 0.05<p<0.02), Bhat-Sunni Muslim (χ^2=44, d.f.=1, 0.001<p), Chirimar-Mazbi Sikh (χ^2=4.857, d.f.=1, 0.05<p<0.02), Chirimar-Sunni Muslim (χ^2=28.692, d.f.=1, 0.001<p), Mazbi Sikh-Singikat (χ^2=7.954, d.f.=1, 0.01<p<0.001), Mazbi Sikh-Sunni Muslim (χ^2=11.414, d.f.=1, 0.001<p), Rahbari-Sunni Muslim (χ^2=23.783, d.f.=1, 0.001<p), Sikligar-Sunni Muslim (χ^2=23.268, d.f.=1, 0.001<p) and Singikat-Sunni Muslim (χ^2=34.766, d.f.=1, 0.001<p). The total group differences were also significant (χ^2=58.342, d.f.=7, 0.001<p) showing a heterogeneous distribution of this trait among the eight endogamous groups under report (Table 2).

Hand clasping

The frequency of R-type was observed lowest in Balmiki (60%) and highest in Sikligar (88%). The incidence of R-type was higher than L-type in all groups (Table 1). Significant inter-caste difference were recorded between Balmiki-Mazbi Sikh, Balmiki-Sunni Muslim (χ^2=4.761, d.f.=1, 0.05<p<0.02), Balmiki-Sikligar (χ^2=10.187, d.f.=1, 0.01<p<0.001), Bhat-Singikat (χ^2=6.832, d.f.=1, 0.01<p<0.001), Chirimar-Singikat (χ^2=5.827, d.f.=1, 0.02<p<0.001) and Rahbari-Sikligar (χ^2=4, d.f.=1, 0.05<p<0.02). It was non-significant among other cases. The total group differences showed significant chi-square values (χ^2=14.483, d.f.=7, 0.05<p<0.02) pointing to a heterogeneous distribution of this trait (Table 2).

Arm folding

Table 1 shows lowest frequency of R-type in Sikligar (24%) and highest in Singikat (72%). The inter-caste differences were found significant between Balmiki-Sikligar, Rahbari-Sikligar (χ^2=10.666, d.f.=1, 0.01<p<0.001), Bhat-Sikligar (χ^2=7.249, d.f.=1, 0.01<p<0.001), Bhat-Singikat (χ^2=5.086, d.f.=1, 0.02<p<0.001), Chirimar-Mazbi Sikh (χ^2=6.762, d.f.=1, 0.01<p<0.001), Chirimar-Sikligar (χ^2=16.233, d.f.=1, 0.01<p), Sikligar-Singikat (χ^2=23.076, d.f.=1, 0.001<p) and Sikligar-Sunni Muslim (χ^2=9.646, d.f.=1, 0.01<p<0.001). It was non-significant among other castes. Total group differences were significant (χ^2=31.31, d.f.=7, 0.001<p) indicating a heterogeneous distribution of this trait.

Leg folding

The lowest frequency of R-type was observed in Balmiki (40%) and highest (90%) in Bhat and Sikligar (Table 1). The incidence of R-type leg folding was higher than L-type in most caste groups except the Balmiki. The inter-caste differences were found significant between Balmiki- Bhat, Balmiki-Sikligar (χ^2=22.242, d.f.=1, 0.001<p), Balmiki-Chirimar (χ^2=4.058, d.f.=1, 0.05<p<0.02), Balmiki-Mazbi Sikh

(χ^2=14.062, d.f.=1, 0.001<p), Balmiki-Rahbari, Balmiki-Sunni Muslim (χ^2=5.911, d.f.=1, 0.02<p<0.01), Balmiki-Singikat (χ^2=9.465, d.f.=1, 0.01<p<0.001), Bhat-Chirimar (χ^2=8.391, d.f.=1, 0.02<p<0.01), Bhat-Rahbari, Bhat-Sunni Muslim, Rahbari-Sikligar, Sikligar-Sunni Muslim (χ^2=6.25, d.f.=1, 0.02<p<0.001) and Chirimar-Sikligar (χ^2=8.091, d.f.=1, 0.01<p<0.001). the other groups showed non-significant differences. This trait depicted a heterogeneous distribution (χ^2=37.738, d.f.=7, 0.001<p) in overall group (Table 2).

Handedness

Table 1 shows lowest frequency of R-type in Singikat (64%) and highest in Sunni Muslim (98%). The right handed individuals were prominent in all caste groups. The inter-caste differences were significant among Balmiki-Singikat (χ^2=6.453, d.f.=1, 0.02<p<0.01), Bhat-Chirimar (χ^2=6.352, d.f.=1, 0.02<p<0.01), Bhat-Rahbari (χ^2=4.332, d.f.=1, 0.05<p<0.02), Bhat-Singikat (χ^2=13.562, d.f.=1, 0.001<p), Chirimar-Sunni Muslim (χ^2=10.698, d.f.=1, 0.01<p<0.001), Mazbi Sikh-Singikat (χ^2=7.894, d.f.=1, 0.01<p<0.001), Rahbari-Sunni Muslim (χ^2=8.273, d.f.=1, 0.01<p<0.001), Sikligar-Singikat (χ^2=4.109, d.f.=1, 0.05<p<0.02), Sikligar-Sunni Muslim (χ^2=7.111, d.f.=1, 0.01<p<0.001) and Singikat-Sunni Muslim (χ^2=18.83, d.f.=1, 0.001<p). The distribution of this trait in total group was heterogeneous (χ^2=29.104, d.f.=7, 0.001<p).

Colour-blindness

The frequency of colour-blindness was found nil, for all the subjects tested showed normal colour vision.

ABO blood group system

The phenotype numbers, allele frequencies and chi-square values for ABO system among eight caste groups are given in table 3. The frequency of A allele varied from a minimum of 0.114 in Rahbari to a maximum of 0.310 in Singikat. The B allele frequency was found to be maximum (0.416) in Bhat and minimum (0.224) in Chirimar. There was preponderance of the B allele over the A allele in all the caste groups except in Singikat where the incidence of both the alleles was found equal (0.310). The blood group O has maximum allele frequency (0.652) in Rahbari and minimum (0.380) in Singikat. The distribution of ABO blood group system was found to be statistically significant in Chirimar (Table 3). The other caste populations showed non-significant values.

The chi-square test for inter-group comparisons revealed that Balmiki were significantly different from Bhat (χ^2=7.682, d.f.=3, 0.01<p<0.05) and Chirimar (χ^2=13.563, d.f.=3, 0.01<p<0.001). Similarly, Bhat differed from Chirimar (χ^2=14.281, d.f.=3, 0.01<p<0.001) and Rahbari (χ^2=5.111, d.f.=3, 0.01<p<0.05). Likewise, Chirimar differentiated themselves from Mazbi Sikh (χ^2=10.092, d.f.=3, 0.01<p<0.001), Rahbari (χ^2=10.992, d.f.=3, 0.001<p), Singikat (χ^2=10.148, d.f.=3, 0.001<p) and Sunni Muslim (χ^2=10.312, d.f.=3, 0.001<p). All other inter-group differences were found to be non-significant. The overall distribution of ABO blood group system among eight caste populations during the study was found to be heterogeneous, showing statistically significant difference (χ^2=32.564, d.f.=21, 0.01<p<0.05).

Rh(D) blood group system

The phenotypes and allele frequencies of Rh(D) blood group system are presented in table 4. In the present caste populations the incidence of Rh(D) negative was found to be highly variable. It varied from the lowest (4%) in Mazbi Sikh to the highest (26%) in Singikat. The latter value is quite high as compared to the range in remaining caste groups (4-14%). The difference was also reflected in allele frequencies where in Singikat a comparatively high value of the recessive allele d (0.509) sets them apart from others (range 0.200-0.374).

The distribution Rh(D) blood group system in the present caste populations was found to be statistically significant in Mazbi Sikh (χ^2=3.303, d.f.=1, 0.01<p<0.001) and in Singikat (χ^2=8.331, d.f.=1, 0.01<p<0.001). The others showed non-significant values. The chi-square test for inter-group comparisons showed that Balmiki were significantly different from Singikat (χ^2=3.182, d.f.=1, 0.01<p<0.05); Bhat- Mazbi Sikh and Mazbi Sikh-Singikat (χ^2=3.052, d.f.=1, 0.01<p<0.05); Chirimar-Singikat, Rahbari-Singikat and Singikat-Sunni Muslim (χ^2=4.326, d.f.=1, 0.05<p<0.02). Similar differences were also observed between Mazbi Sikh and Singikat (χ^2=9.490, d.f.=1, 0.01<p<0.001).

The overall distribution of Rh(D) blood group system among eight endogamous groups of this study was found to be heterogeneous, showing statistically significant difference (χ^2=12.760, d.f.=7, 0.01<p<0.05).

Table 1: Percentage frequency distribution of various traits among eight endogamous groups

Endogamous group	n	Ear lobe attachment (Attached)	Hand clasping (R-type)	Arm folding (R-type)	Leg folding (R-type)	Handedness (R-type)
Balmiki	50	56	60	56	46	86
Bhat	50	78	66	50	90	94
Chirimar	50	64	68	64	66	76
Mazbi Sikh	50	42	80	38	82	88
Rahbari	50	60	72	56	70	80
Sikligar	50	58	88	24	90	82
Singikat	50	70	78	72	76	64
Sunni Muslim	50	12	80	54	70	98

Table 2: Chi-square values for total group differences in traits studied among eight endogamous groups

Sr. no.	Trait	χ^2	d.f.	p	Significance	Distribution
1	Ear lobe attachment	58.342	7	0.001<p	Significant	Heterogeneous
2	Hand clasping	14.483	7	0.05<p<0.02	Significant	Heterogeneous
3	Arm folding	31.310	7	0.001<p	Significant	Heterogeneous
4	Leg folding	37.738	7	0.001<p	Significant	Heterogeneous
5	Handedness	29.104	7	0.001<p	Significant	Heterogeneous

Table 3: Phenotypes and gene frequencies of ABO blood group among eight endogamous groups of Haryana.

Endogamous group (Number tested)		ABO Phenotype				ABO Allele frequency			Chi-square (d.f.=3)
		A	B	AB	O	A	B	O	
Balmiki (50)	Obs.	10	12	15	13	0.273	0.313	0.414	3.483
	Exp.	8.56	15.00	17.80	8.64				
Bhat (50)	Obs.	7	12	28	3	0.179	0.416	0.405	4.199
	Exp.	8.20	8.85	25.50	7.45				
Chirimar (50)	Obs.	23	6	13	8	0.143	0.224	0.633	10.025*
	Exp.	20.06	10.06	16.68	3.20				
Mazbi Sikh (50)	Obs.	14	11	20	5	0.175	0.293	0.532	0.010
	Exp.	14.16	10.82	19.86	5.16				
Rahbari (50)	Obs.	22	7	17	4	0.114	0.234	0.652	0.716
	Exp.	21.25	8.14	17.95	2.66				
Sikligar (50)	Obs.	16	7	23	4	0.116	0.322	0.562	0.067
	Exp.	15.80	7.19	23.27	3.74				
Singikat (50)	Obs.	7	17	17	9	0.310	0.310	0.380	0.068
	Exp.	7.22	16.58	16.58	9.62				
Sunni Muslim (50)	Obs.	8	12	23	7	0.217	0.375	0.408	0.245
	Exp.	8.32	11.2	22.35	8.13				

Obs.= Observed, Exp.= Expected
**significant (0.02<p<0.01)*

Table 4: Phenotypes and allele frequencies of Rh (D) blood groups among eight endogamous groups of Haryana

Endogamous group	Number tested (n)	Rh (D) Phenotype		Rh (D) Allele frequency		Chi-square (d.f. 1)
		$Rh(D)^+$	$Rh(D)^-$	D	d	
Balmiki	50	44	6	0.654	0.346	0.011
Bhat	50	43	7	0.626	0.374	0.102
Chirimar	50	45	5	0.684	0.316	0.286
Mazbi Sikh	50	48	2	0.800	0.200	3.303*
Rahbari	50	45	5	0.684	0.316	0.286
Sikligar	50	43	7	0.626	0.374	0.102
Singikat	50	37	13	0.491	0.509	8.331*
Sunni Muslim	50	45	5	0.684	0.316	0.286

**Significant (0.02<p<0.01)*

DISCUSSION

In the populations of North-West India, the frequency of attached ear lobe had been recorded lowest in Gujjar at 7.74% (Malhotra 1976) and highest in Jain at 74% (Yadav *et al.* 2000). Thus, in the present material the frequency range of this trait (12-78%) showed slightly higher value in upper maxima in case of the Bhat.

The frequency of hand clasping in the present study ranged from 60% in Balmiki to 88% in Sikligar. It deviated in the upper maxima in comparison with the range for other North-West Indian populations, i.e., 40% in Rajput (Bhasin *et al.* 1992) to 7.9% in Jain (Yadav *et al.* 2000).

The frequency ramge of arm folding is 24% in Sikligar to 72% in Singikat in the present material. In other populations of North-West India, it was recorded as a lowest in Gaddi at 31.9% (Bhasin *et al.* 1992) and highest in Jain at 78% (Yadav *et al.* 2000). Thus, the frequency of this trait in the lower minima in Sikligar showed a deviation from that of earlier studies.

The frequency range obtained for leg folding presently is 40% in Balmiki to 90% in Bhat and Sikligar. It shows deviations both in maximal and minimal values in comparison with the range for other populations of Haryana, i.e., 58% in Lohar (Yadav *et al.* 1997a) to 87% in Chadha (Yadav *et al.* 2000).

The frequency of R-type handedness varied from 64% in Singikat to 98% in Sunni Muslim. It shows deviations in lower minima as compared with the range for other populations of Haryana, i.e., 83% Sunar (Yadav *et al.* 1997b) and 100% Ahir and Chamar (Malhotra 1976).

In the present material not a single colour blind individual was observed, although the incidence of this trait has earlier been recorded in several populations of North-West India (Yadav *et al.* 1997a; Bhasin *et al.* 1992).

Earlier reports of Haryana populations showed that the frequency of A allele varied from 0.068 in Khatri (Kushwaha 1990b) to 0.356 in Bazigar (Yadav *et al.* 1997b). The variability of this allele observed in the present material (0.114-0.310) thus fitted well within the range of earlier studies. The frequency of B allele in Haryana populations was reported to vary from 0.185 in Sunar to 0.387 in Khatri (Yadav *et al.* 1997b). Comparatively the present range (0.224-0.416) showed a higher value in the upper maximum in case of Bhat. Earlier studies on Haryana population revealed that the frequency of O allele varied from as low as 0.366 in Bazigar (Yadav *et al.* 1997b) to as high as 0.664 in Gujjar (Kushwaha 1990b). The range observed in the present caste populations (0.380-0.652) thus is in agreement with the earlier reports.

From the earlier studies on Haryana populations, the range derived for the incidence of d allele was found to vary between nil to 0.420 (Yadav and Gupta 1992; Yadav *et al.* 1997b). The range of d allele frequency observed in the present caste groups (0.200-0.509) showed comparatively higher value in the upper maximum in Singikat.

CONCLUSION

In conclusion, the frequency of morphological and behavioural traits in the present material showed slight deviations either in the upper or in the lower minima as compared with the range recorded in other groups belonging to North-West India. Besides, a new range of frequency is obtained with regard to leg folding in these populations. The present investigation revealed that these is appreciable variations in the distribution of the ABO and Rh(D) blood groups among Haryana populations. However, the allele frequencies recorded were quite within the North-West Indian ranges. The genetic heterogeneity such as evidenced by Chirimar in the ABO system and Singikat in the Rh(D) system may well be a reflection of their diverse ethnic backgrounds or effect of some local selective pressures or both. All the populations are, however, in Hardy- Weinberg equilibrium for these blood groups.

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