

Distribution of Blood Groups in Garhwal Himalayas, Uttar Pradesh, India

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ABSTRACT Data are presented on the distribution of the ABO, Rh(D) and Kell blood groups in 14 regional samples of the Brahmin, Rajput, Scheduled Castes and Bhotia populations inhabiting 4 different districts of Garhwal division of Uttar Pradesh. Usually preponderance of blood group A over B was observed in the caste material, while the opposite was true for the tribal (Bhotia) material. The latter was also characterised by complete absence of the Rh(D)- phenotype. The Kell system has been studied here for the first time from Garhwal. The possible causes of the observed variation are discussed.

INTRODUCTION

The Uttar Pradesh (U.P.) Himalayas extend over 51,125 sq. km, constituting about 17% of the total geographical area of the State (Singh, 1989). Administratively, this territory is divided into two divisions namely Garhwal and Kumaon, and eight districts namely Uttarkashi, Tehri, Pauri, Chamoli and Dehradun falling in the Garhwal division, and Nainital, Almora and Pithoragarh in the Kumaon division. Spread over an area of 30,090 sq. km the five districts of Garhwal division, according to the 1981 Census have a combined population of 2,453,000.

Three main endogamous castes—the Brahmin, Rajput and Scheduled Castes—constitute the bulk of the Hindu population of Garhwal Himalayas. In addition, the Bhotia—a Scheduled Tribe—inhabit two border districts of the region viz. Uttarkashi and Chamoli. The origins of the various Brahmin and Rajput sub-castes of Garhwal have been extensively investigated by Ratoodi (1988), and in almost all cases these have been traced from different places in plains of India over different periods

of time. On the other hand, the Scheduled Castes are an aggregate of low occupational people who are usually considered as autochthones of the region. Both physically and culturally, the tribal Bhotia who are predominantly of Mongoloid derivation differ from the Hindu population.

As for the populations of the Garhwal Himalayas, serological studies have been conducted earlier by Kaul (1953), Mathew (1959), Tiwari and Bhasin (1968) and Tiwari (1982). The importance of this study lies in the fact that this is the first investigation which reports district-wise distribution of the blood groups in both tribal and non-tribal populations inhabiting this hilly area.

SUBJECTS, MATERIAL AND METHODS

The subjects were local students attending various schools and colleges in Uttarkashi, Tehri, Pauri and Chamoli districts of Garhwal division of Uttar Pradesh. These included individuals from both sexes selected at random, but excluded any close relatives or outsiders. For a collection from a particular district only subjects born in and domicile of that district were considered.

A total of 1,924 finger prick blood samples from four regional groups each of the Brahmin (n=623), Rajput (n=934) and Scheduled Castes (n=143) and two of the Bhotia (n=224) was collected district-wise in batches during six different field works spread over a period of about 3 years from September 1988 to October 1991.

Serological tests using monoclonal anti-A, anti-B and anti-D (complete) were performed both in the field and in the laboratory at Patiala. In the field, blood grouping was done at the time of collection of the specimens, using the slide method. All results were subsequently confirmed at Patiala using the tube method. In rare cases of any discrepancy, the results obtained using the tube method were considered. Tests involving anti-A₁, were performed only at Patiala using the tile method; unfortunately the batch of blood samples collected from Tehri district could not be sub-typed using this lectin. For the Kell system, because of limited reagent, material collected only from Chamoli district was typed and the tests were performed at Patiala by slide method using incomplete anti-K.

The allele frequencies in the ABO system were calculated using the formulae given by Yasuda (1984) which yield estimates quite close to maximum likelihood solutions; for other systems the square root method (Mourant et al., 1976) was used.

RESULTS

The ABO System

Table 1 lists district-wise distribution of the ABO blood groups in 14 regional samples of different caste and tribal populations of Garhwal. In no sample was there any marked departure from the Hardy-Weinberg expectations, the differences being statistically non-significant for each sample as well as for the total material tested from each district surveyed.

Examination of the ABO allele frequencies showed that both in Tehri and Pauri districts, the frequency of the A ($A_1 + A_2$) allele was always higher than that of the B allele; the only exception being the Scheduled Castes sample from the latter district. On the other hand, in the border district of Chamoli, there was preponderance of the B allele over the A

allele. As for another border district of Uttarkashi, a mixed trend was observed. It is interesting to note that both the Bhotia samples had shown rather high frequencies of the B allele. The A₂ allele was detected in 9 out of the 11 population samples tested using anti-A₁ lectin from Uttarkashi, Pauri and Chamoli districts; the allele being lacking from two rather small Scheduled Castes samples from the latter two districts. When present, the incidence of the A₂ allele in the present material from Garhwal varied from 1.8 to 5.5% (Table 1).

Inter-group comparisons for the distribution of the ABO blood groups revealed significant differences between the Rajput and Brahmin ($\chi^2 = 22.03$, d.f. = 5, $0.001 > p > 0.005$), and between Rajput and Bhotia ($\chi^2 = 17.92$, d.f. = 5, $0.05 > p > 0.001$) in Uttarkashi district. As for the populations of the other districts, it were only the Brahmin and Scheduled Castes of Pauri district that showed such differences ($\chi^2 = 14.42$, d.f. = 5, $0.025 > p > 0.01$). In fact, barring Uttarkashi district ($\chi^2 = 40.25$, d.f. = 15, $p < 0.0005$), the distribution of this blood group system was found to be rather homogeneous among populations of each of the remaining three districts. However, an overall comparison of the 14 caste and tribal samples investigated here from 4 different districts of Garhwal demonstrated great heterogeneity in the ABO system in this region ($\chi^2 = 68.06$, d.f. = 39, $0.005 > p > 0.001$).

The Rh(D) System

The distribution of the Rh(D) system (Table 2) also showed an interesting pattern. While the proportion of the Rh(D)- varied from as low as 1.67% in the Brahmin of Chamoli district to as high as 7.82% in their counterpart in Pauri district, both the Bhotia samples from the border districts as well as the Scheduled Castes samples from Tehri and Chamoli districts stand out with complete absence of this phenotype in them. When present, the

Table 1: Distribution of the ABO blood groups in various regional population groups of Garhwal

Area and population group	n		Phenotypes						Allele frequencies				χ^2 d.f. = 5
			O	A ₁	A ₂	B	A ₁ B	A ₂ B	A ₁	A ₂	B	O	
Uttarkashi District													
Brahmin	116	Obs.	23	26	6	42	13	6	0.186	0.055	0.309	0.450	1.14
	115.99	Exp.	23.49	25.80	6.09	43.34	13.33	3.94					
Rajput	200	Obs.	56	76	4	48	15	1	0.266	0.019	0.178	0.537	1.33
	199.99	Exp.	57.67	73.31	4.15	44.57	18.94	1.35					
Scheduled Castes	45	Obs.	13	11	2	12	7	0	0.217	0.038	0.233	0.512	2.63
	45.01	Exp.	11.80	12.86	1.82	13.18	4.55	0.80					
Bhotia	97	Obs.	27	16	2	41	10	1	0.143	0.019	0.316	0.522	0.28
	97	Exp.	26.43	16.99	1.96	41.69	8.77	1.16					
Total	458	Obs.	119	129	14	143	45	8	0.214	0.029	0.244	0.513	0.58
	458	Exp.	120.53	127.22	14.01	141.93	47.83	6.48					
Tehri District													
Brahmin	144	Obs.	36	52 ¹	—	39	17 ²	—	0.279 ³	—	0.219	0.502	0.01 ⁴
	144.01	Exp.	36.29	51.55 ¹		38.57	17.60 ²						
Rajput	188	Obs.	43	60 ¹	—	55	30 ²	—	0.274 ³	—	0.256	0.470	0.77 ⁴
	188	Exp.	41.53	62.54 ¹		57.56	26.37 ²						
Scheduled Castes	22	Obs.	3	11 ¹	—	7	1 ²	—	0.365 ³	—	0.228	0.407	2.89 ⁴
	22	Exp.	3.64	9.47 ¹		5.23	3.66 ²						
Total	354	Obs.	82	123 ¹	—	101	48 ²	—	0.281 ³	—	0.239	0.480	0.01 ⁴
	354	Exp.	81.56	123.45		101.4	47.55 ²						
Pauri District													
Brahmin	243	Obs.	75	84	5	56	20	3	0.245	0.018	0.179	0.558	1.40
	243	Exp.	75.66	83.17	4.96	56.33	21.31	1.57					
Rajput	345	Obs.	95	104	9	99	29	9	0.219	0.025	0.224	0.532	7.74
	344.99	Exp.	97.64	100.71	9.39	99.54	33.85	3.86					
Scheduled Castes	46	Obs.	10	9	0	22	5	0	0.168	0.000	0.361	0.471	0.09 ⁴
	46	Exp.	10.20	8.58	0.00	21.64	5.58	0.00					
Total	634	Obs.	180	197	14	177	54	12	0.225	0.021	0.215	0.539	8.00
	634	Exp.	184.19	191.86	14.63	176.25	61.34	5.73					
Chamoli District													
Brahmin	120	Obs.	27	30	5	45	11	2	0.191	0.043	0.287	0.479	0.89
	120.01	Exp.	27.53	28.31	5.17	42.88	13.16	2.96					
Rajput	201	Obs.	49	49	8	70	23	2	0.198	0.038	0.274	0.490	1.26
	201.01	Exp.	48.26	49.91	7.78	69.06	21.81	4.19					
Scheduled Castes	30	Obs.	11	6	0	10	3	0	0.161	0.000	0.243	0.596	0.25 ⁴
	30	Exp.	10.66	6.53	0.00	10.46	2.35	0.00					
Bhotia	127	Obs.	24	33	2	50	15	3	0.215	0.018	0.322	0.445	2.14
	127	Exp.	25.15	31.16	2.08	49.56	17.58	1.47					
Total	478	Obs.	111	118	15	175	52	7	0.198	0.032	0.287	0.483	0.55
	478	Exp.	111.51	116.22	15.27	171.89	54.33	8.78					

1. A, 2. AB, 3. A, 4. d.f. =3

Table 2: Distribution of the Rh(D) blood groups in various regional population groups of Garhwal

Area and population group	n	Phenotypes		Allele frequencies	
		Rh(D)+	Rh(D)-	D	d
<i>Uttarkashi District</i>					
Brahmin	116	109	7 (6.03)	0.754	0.246
Rajput	200	192	8 (4.00)	0.800	0.200
Scheduled Castes	45	43	2 (4.44)	0.789	0.211
Bhotia	97	97	0 (0.00)	1.000	0.000
Total	458	441	17 (3.71)	0.807	0.193
<i>Tehri District</i>					
Brahmin	144	137	7 (4.86)	0.780	0.220
Rajput	188	184	4 (2.13)	0.854	0.146
Scheduled Castes	22	22	0 (0.00)	1.000	0.000
Total	354	343	11 (3.11)	0.824	0.176
<i>Pauri District</i>					
Brahmin	243	224	19 (7.82)	0.720	0.280
Rajput	345	328	17 (4.93)	0.778	0.222
Scheduled Castes	46	43	3 (6.52)	0.745	0.255
Total	634	595	39 (6.15)	0.752	0.248
<i>Chamoli District</i>					
Brahmin	120	118	2 (1.67)	0.871	0.129
Rajput	201	196	5 (2.49)	0.842	0.158
Scheduled Castes	30	30	0 (0.00)	1.000	0.000
Bhotia	127	127	0 (0.00)	1.000	0.000
Total	478	471	7 (1.46)	0.879	0.121

Figures in paranthesis indicate percentages

frequency of the *d* allele in the present material from Garhwal was recorded in the range of 0.129-0.280.

The Bhotia of Uttarkashi district showed significant heterogeneity in the distribution of the Rh(D) blood groups with all caste groups of this district viz. the Brahmin ($\chi^2 = 6.06$, d.f. =1, $0.025 > p > 0.01$), Rajput ($\chi^2 = 3.98$, d.f. =1, $0.05 > p > 0.025$) and Scheduled Castes ($\chi^2 = 4.41$, d.f. =1, $0.05 > p > 0.025$). However, within each district, including Uttarkashi, the overall variability of this blood group system did not attain statistical significance. But as in the ABO system, in the Rh(D) system also appreciable heterogeneity was discernible when the entire material tested here from Garhwal was considered together ($\chi^2 = 29.38$, d.f. =13, $0.01 > p > 0.005$).

The Kell System

Of the 419 blood samples tested for the Kell blood groups from the Chamoli district 6 cases of K+ were detected, giving an overall frequency of 1.43% for this phenotype (Table 3). The Brahmin showed the highest incidence of the Kell (*K*) allele (1.5%), followed by the Rajput (0.6%) and Bhotia (0.4%), while the allele was found to be lacking in the Scheduled Castes.

DISCUSSION

“There is a definite patterning in the distribution of ABO blood groups in the populations of the Himalayas” (Tiwari, 1972). In this vast hilly tract of India, running from Jammu and Kashmir in the west to Arunachal Pradesh in the east, the frequency of group

Table 3: Distribution of the Kell blood groups in various population groups of Chamoli district

Area and population group	n	Phenotypes		Allele frequencies	
		K+	K-	K	k
Brahmin	99	3 (3.03)	96	0.015	0.985
Rajput	170	2 (1.18)	168	0.006	0.994
Scheduled Castes	29	0 (0.00)	29	0.000	1.000
Bhotia	121	1 (0.83)	120	0.004	0.996
Total	419	6 (1.43)	413	0.007	0.993

Figures in paranthesis indicate percentages

B is higher than that of group A among caste groups inhabiting the foot-hills or southern region of the Himalayas. Populations residing in the zone adjoining Tibet in the northern region of the Himalayas also display a similar picture of the ABO distribution. Sandwiched between these two almost parallel stretches of high group B territories is a narrow belt of area characterised more often than not by preponderance of group A over group B.

Viewed against this background, the variation observed in the ABO system in the present caste and tribal material from Garhwal is in conformity with the Himalayan pattern. The Garhwal Himalayas are a part of that middle tract of the Himalayas where among caste populations the frequency of group A has been repeatedly shown to be consistently higher than that of group B (Kaul, 1953; Mathews, 1959; Tiwari and Bhasin, 1968). This is also true of the present regional samples of the Brahmin and Rajput belonging to Tehri and Pauri districts. The preponderance of group B over group A in some caste samples, especially in the Chamoli district, was somewhat surprising, but then such a situation does occur even in neighbouring Kumaon region (Tiwari, 1954; Bird and Krishnaswami, 1955). The tribal population of Bhotia confined mainly to three border districts of the U.P. Himalayas viz., Uttarkashi, Chamoli and Pithoragarh is

characterised by relatively higher incidence of group B always exceeding that of group A (Tiwari, 1952, 1982). The two different samples of this tribe studied from Uttarkashi and Chamoli districts of Garhwal division in this investigation have also shown similar results; the frequency of group B being comparatively rather high in both of them.

Data on the Rh blood groups from Garhwal are limited to a couple of earlier detailed reports on this system. However, for the present purpose it would suffice to compare only the Rh(D)- incidence, and it was observed that the range recorded in the caste material of this study (1.67-7.82%) was similar to that reported earlier for Brahmin and Rajput of Garhwal (4.81-7%; Tiwari and Bhasin, 1968). Furthermore, the complete absence of this phenotype in the present Bhotia samples was also in accord with previous findings on this tribe (Tiwari, 1982). On the other hand no data are available for the Kell blood groups on any hill population of Garhwal, and in fact this is the first report on the distribution of this rare serological marker in entire U.P. Himalayas.

In conclusion, the present serological investigation has demonstrated great heterogeneity in the distribution of the ABO and Rh(D) blood groups among caste and tribal populations inhabiting Garhwal Himalayas, albeit at regional (district) level there was little evidence to support such a contention. Much of this heterogeneity can be attributed to diverse ethnic backgrounds of these populations. Preponderance of the B blood group and complete absence of the Rh(D)- phenotype observed in both tribal Bhotia groups of this study is indeed characteristic also of Tibetans, several immigrant samples of which have now been investigated from different parts of India (Mourant et al., 1976; Bhasin et al., 1992). This suggests close genetic affinities between different Bhotia groups of Garhwal and Tibetans. In fact, certain Bhotia groups of U.P. Himalayas claim to be direct or more or less

unmixed descendants of Tibetans (Tiwari, 1982). In addition, close geographical proximity of the border districts of Uttarkashi and Chamoli to Tibet in the north as well as trade and cultural links between Bhotias and Tibetans over centuries have provided ample opportunities for continued gene flow between these two populations. On the other hand, there is no evidence of any apparent Mongoloid influence on the genetic make up of the caste population of Garhwal Himalayas, barring the border areas where such a possibility can not be completely ruled out.

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