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Erythrocyte Enzyme Variation in Some Caste Populations of Chamba, Himachal Pradesh

R.M.S. Chahal, Archana Mahajan and Parminder Singh
Department of Human Biology, Punjabi University, Patiala 147 002, Punjab, India

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ABSTRACT Four urban endogamous caste groups of the historical town of Chamba in the Chamba district (Himachal Pradesh)—the Brahmin, Rajput, Khatri and Mahajan, were examined using phenotype and allele frequency data from six polymorphic erythrocyte enzyme systems—glyoxalase I, esterase D, adenylate kinase, phosphoglucomutase, acid phosphatase and glucose phosphate isomerase. There was no significant genetic heterogeneity between the caste groups for any of the systems investigated, and overall they showed close resemblance in allele frequencies to their counterparts in rural areas of this remote hill district, and populations of the North Indian region in general.

Due to remoteness of the area and mystery surrounding the origins of its people, the contemporary hill populations of the Chamba district in Himachal Pradesh have been the subject of some recent detailed serological and biochemical investigations (Chahal, 1981; Chahal et al., 1982; Singh et al., 1982). However, barring an ABO blood group report (Chatterjee, 1960), no other genetic data are available on the urban-inhabitants of the historical town of Chamba, the district headquarters. The aim of the present biochemical enquiry, therefore, is to study the four major endogamous population groups of the Chamba town—the Brahmin, Rajput, Khatri and Mahajan castes, using data on the variabilities of six erythrocyte enzyme systems—glyoxalase I (GLO I), esterase D (EsD), adenylate kinase (AK), phosphoglucomutase (PGM_1), acid phosphatase (AP) and glucose phosphate isomerase (GPI).

MATERIAL AND METHODS

The material consists of haemolysates from a total of 326 finger prick blood samples collected from random not closely related 72 Brahmin, 112 Rajput, 79 Khatri and 63 Mahajan subjects residing in the Chamba town of the Chamba district, Himachal Pradesh. The typing of GLO I was carried out using the mixed starch/agarose gel electrophoretic technique of Scott and Fowler (1982). Phenotypes of EsD, AK, PGM_1, AP and GPI were analysed by horizontal starch gel electrophoresis essentially as described in Harris and Hopkinson (1976).

RESULTS AND DISCUSSION

The phenotype data for the six enzyme systems investigated are presented in table 1, and the corresponding allele frequencies in table 2. The phenotypic distributions of different enzymes examined in the four castes are in genetic equilibrium—the deviations from the Hardy-Weinberg proportions being statistically non-significant for each system tested (Table 1).

Glyoxalase I: In the present samples the range of the GLO^1 frequency is wide, varying from 16.7% in the Brahmin to 26.6% in the Khatri, albeit comparable to that recorded for the North Indian populations (14.7 - 30.3%, Chahal et al., 1986a). And although the differences in the total material are not statistically significant ($\chi^2 = 7.914$, df 6, $p > 0.20$), these two castes show significant heterogeneity ($\chi^2 = 7.023$, df 2, $0.05 > p > 0.02$). For GLO I, there are three countryside Rajput samples available from the Chamba district for comparison in which the GLO^1 frequency varies between 24.4 and 26.5% (Chahal, 1981). The values observed in the present urban Rajput sample (23.2%) and Khatri

Table 1: Phenotype distribution of various erythrocyte enzyme polymorphisms in four caste populations of Chamba

Enzyme system	*Phenotype*	*Brahmin*		*Rajput*		*Khatri*		*Mahajan*	
		No. Obs.	*No. Exp.*	*No. Obs.*	*No. Exp.*	*No. Obs.*	*No. Exp.*	*No. Obs.*	*No. Exp.*
GLO I									
	1-1	3	2.01	5	6.08	3	5.59	2	2.27
	2-1	18	20.03	42	39.91	36	30.85	20	19.39
	2-2	51	49.96	65	66.06	40	42.56	41	41.33
	Total	72	72.00	112	112.00	79	79.00	63	62.99
	χ^2	0.715		0.302		2.214		0.054	
EsD									
	1-1	45	42.80	72	71.50	50	49.43	40	36.58
	2-1	21	25.42	35	35.97	25	26.12	16	22.85
	2-2	6	3.78	5	4.53	4	3.45	7	3.57
	Total	72	72.00	112	112.00	79	79.00	63	63.00
	χ^2	2.185		0.079		0.142		5.669	
AK									
	1-1	54	54.25	96	96.66	64	64.70	48	48.90
	2-1	17	16.50	16	14.77	15	13.58	15	13.21
	2-2	1	1.25	-	0.56	-	0.71	-	0.89
	Total	72	72.00	112	111.99	79	78.99	63	63.00
	χ^2	0.005		0.034		0.043		0.074	
PGM_1									
	1-1	37	36.12	62	60.83	43	39.71	25	28.03
	2-1	28	29.75	40	42.76	26	32.60	33	27.31
	2-2	7	6.13	9	7.51	10	6.69	4	6.65
	7-1	-	0.00	1	0.66	-	0.00	1	0.67
	7-2	-	0.00	-	0.23	-	0.00	-	0.33
	Total	72	72.00	112	111.99	79	79.00	63	62.99
	χ^2	0.248		0.453		3.247		2.679	
AP									
	A	3	6.52	12	11.54	8	10.29	7	5.45
	BA	37	29.39	48	48.82	41	36.45	23	26.15
	B	29	33.12	52	51.64	30	32.26	33	31.40
	CA	-	0.60	-	0.00	-	0.00	-	0.00
	CB	2	1.36	-	0.00	-	0.00	-	0.00
	Total	71	70.99	112	112.00	79	79.00	63	63.00
	χ^2	4.626		0.035		1.236		0.902	
GPI									
	1-1	70	70.00	108	108.00	78	78.05	61	61.00
	3-1	2	1.99	4	3.96	1	0.94	2	1.98
	3-3	-	0.01	-	0.04	-	0.00	-	0.02
	Total	72	72.00	112	112.00	79	78.99	63	63.00

Table 2: Allele frequencies in four caste populations of Chamba

Enzyme system	*Allele*	*Brahmin*	*Rajput*	*Khatri*	*Mahajan*
GLO I					
	GLO^1	0.167	0.232	0.266	0.190
	GLO^2	0.833	0.768	0.734	0.810
EsD					
	EsD^1	0.771	0.799	0.791	0.762
	EsD^2	0.229	0.201	0.209	0.238
AK					
	AK^1	0.868	0.929	0.905	0.881
	AK^2	0.132	0.071	0.095	0.119
PGM_1					
	PGM_1^1	0.708	0.737	0.709	0.667
	PGM_1^2	0.292	0.259	0.291	0.325
	PGM_1^7	0.000	0.004	0.000	0.008
AP					
	P^a	0.309	0.321	0.361	0.294
	P^b	0.683	0.679	0.639	0.706
	P^c	0.014	0.000	0.000	0.000
GPI					
	GPI^1	0.986	0.982	0.994	0.984
	GPI^3	0.014	0.018	0.006	0.016

(26.1%) are therefore very similar, while the ramaining two groups (the Brahmin and Mahajan) with their comparatively low (below 20%) GLO^1 frequencies stand out from other contemporary populations of the district.

Esterase D: The variability observed among the Chamba caste groups in the EsD system is small, fitting in a rather narrow EsD^2 range (20.1 -23.8%), and showing phenotypic homogeneity (χ^2 = 3.858, df 6, p> 0.50). A few rural populations investigated from the Chamba district have recorded rather diverse EsD^2 frequencies from as low as 4.5% (Singh et al., 1982) to as high as 32.5% (Chahal, 1981). Nonetheless, the frequencies observed in the urban material of this study (20.1 - 23.8%) are compatible with those of the Gaddi Brahmin (25.6%) and Gaddi Rajput (24.3%) from Bharmour (Chahal et al., 1982) and Rajput of Chuwari (24.3%, Chahal, 1981) studied from the same district. In fact such resemblance in this enzyme frequencies can be extended to several North Indian populations examined from other regions of Himachal Pradesh, Punjab, Uttar Pradesh, Chandigarh and Delhi (Chahal et al., 1986b).

Adenylate kinase: There is a great heterogeneity discernible in the distribution of adenylate kinase gene frequencies in the present groups (AK^2 range 7.1-13.2%), a pattern characteristic also of other populations tested from various rural areas of the Chamba district (range 7.7 - 11.5%, Chahal et al., 1986c). As for GLO I, in this system too there is a closeness in the AK^2 frequencies between Rajput (7.1%) and Khatri (9.5%) on one hand, and Brahmin (13.2%) and Mahajan (11.9%) on the other. However, the overall differences in the urban sample studied here are not statistically significant (χ^2 = 4.066, df 3, p>0.20).

Phosphoglucomutase: The four castes also exhibit considerable variation at the PGM_1 locus (PGM_1^2 range 25.9-32.5%), and in fact the Khatri and Mahajan are significantly different from each other for this system (χ^2 = 6.684, df 2, 0.05>p> 0.02). But in the total caste material examined here there is no suggestion of any appreciable heterogeneity (χ^2=8.383, df 6, p>0.20). It is interesting to note that in comparison to the present urban samples, most rural populations investigated from the Chamba district (Chahal, 1981; Chahal et al., 1982; Singh et al., 1982) show rather low PGM_1^2 frequencies. Sporadic occurrence of the rare PGM_1^7 has been reported in Himachal Pradesh (Chahal, 1981) and North India (Blake et al., 1971; Papiha et al., 1972, 1976, 1982). Therefore, the detection of a rare PGM_1 phenotype 7-1, due to this allele, in this case in two subjects from the Chamba town is not unusual and is in accord with the previous findings from this region. No variant was found at the PGM_2 locus, examined alongwith the PGM_1 locus, in any of the 326 haemolysates tested.

Acid phosphatase: The P^a and P^b are the two predominant alleles of the AP system, and in the

Rajput, Khatri and Mahajan also together they constitute the entire variation of the system. The third allele, P^c is present only in the Brahmin sample, in low albeit polymorphic proportion (1.4%). The four urban caste groups are genetically homogeneous for the distribution of this enzyme (χ^2 = 7.704, df 6, p>0.20) and show very similar allele frequencies (P^a range from 32.1%), which are consistent with those recorded in some rural populations examined from the Chamba district, and North India in general (Chahal et al., 1985). The distribution of the P^a allele in India is essentially non-tribal, for it is absent in most tribal groups, but present in the non-tribals at frequencies up to 2% (Roberts et al., 1980). The two CB heterozygotes in the Brahmin sample give the characteristic low P^a frequency found in other non-tribal Indian populations (Chahal et al., 1985).

Glucose phosphate isomerase :Altogether, nine examples of rare electrophoretic variants of GPI, all of the type 3-1, have been detected—the rare type being present in each of the four caste samples tested. Interestingly, in three—the Brahmin, Rajput and Mahajan, the rare allele GPI^3 attains polymorphic proportions. This confirms widespread distribution of this allele in the Chamba district (Chahal, 1981; Chahal et al., 1982). No other rare GPI variant was encountered.

CONCLUSIONS

The variabilities observed in the distributions of various erythrocyte enzyme polymorphisms in the present urban sample from the Chamba district suggest that the genetic composition of the four caste groups investigated is homogeneous, and similar to several other contemporary rural populations of this district. Much of this genetic similarity among the present castes primarily derives from similarities in their ethnic backgrounds and environmental conditions, and particularly in this case, perhaps also from geographical isolation of this remote hill region from the plains of North India.

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