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Distribution of Red Cell Enzymes Among Three Population Groups of Ladakh, Jammu and Kashmir, India

M.K. Bhasin, Asha Khanna and S.M.S. Chahal[1]
Department of Anthropology, University of Delhi, Delhi 110 007, India
1. *Department of Human Biology, Punjabi University, Patiala 147 002, India*

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ABSTRACT This study provides baseline data on the phenotype and gene frequency distributions of seven red cell enzyme systems (AP, ADA, AK, EsD, GPI, GLOI, PGM_1) in two Buddhist populations - Bodhs (Scheduled Tribe) and Tibetans of Leh district and one muslim population - Baltis (Scheduled Tribe) of Kargil district of Ladakh division of Jammu and Kashmir state of India.

Since Smithies (1955) reported the application of the technique of electrophoresis in gel, to study variation in serum proteins, the impetus attached to serological traits in anthropological investigations has shifted to the biochemical polymorphisms. Enzyme electrophoresis has proved to be a powerful tool in population genetics. Erythrocyte enzymes PGM, EsD, AK, ADA, AP, GLOI etc. have been found to be highly polymorphic. The data on the distribution of different red cell enzymes in various populations of the world have been compiled by Mourant et al. (1976), Tills et al. (1983) and Roychoudhury and Nei (1988). Several reports (Bhasin and Fuhrmann, 1972; Singh, 1973; Kirk, 1974; Roychoudhury, 1975; Mourant et al., 1976; Bhasin et al., 1981; Papiha and Chahal, 1984; Chahal et al., 1985, 1986 a, b, c) have from time to time reviewed the available data on the distribution of these polymorphisms in Indian populations.

In the present study, baseline genetic data on seven red cell enzyme systems (AP, ADA, AK, EsD, GPI, GLOI and PGM_1) have been presented among the Bodhs, Baltis and Tibetans of Ladakh, Jammu and Kashmir state of North India, situated in the Western Himalayan region.

MATERIAL AND METHODS

A total of 292 blood samples collected from Bodhs (Scheduled Tribe) and Tibetans of Leh district and 99 samples from Baltis (Scheduled Tribe) from Kargil district of Ladakh division, Jammu and Kashmir were typed for different red cell enzyme systems. The biochemical analysis of red cell lysates was carried out by horizontal electrophoresis using the techniques described by Harris and Hopkinson (1976) for acid phosphatase (AP) and glucose phosphate isomerase (GPI) systems; Scott and Fowler (1982) for glyoxalase I (GLOI) system; Murch et al. (1986) for adenosine deaminase (ADA) and adenylate kinase (AK) systems; and Wraxall and Stolorow (1986) for phosphoglucomutase locus 1 (PGM_1) and esterase D (EsD) systems. The gene frequency calculations have been done after Mourant et al. (1976).

RESULTS AND DISCUSSION

Results for the seven red cell enzyme systems analysed for present populations are given in tables 1 and 2.

Acid phosphatase (AP) system

From table 1, it is observed that the frequency of phenotype B is high among all

the three population groups. Rare phenotype CB was found only among the Baltis of Kargil district. No rare variant has been detected.

The Baltis are showing a higher frequency (30.21 per cent) of gene P^a than that found among both Bodhs (22.91 per cent) and Tibetans (16.82 per cent). The gene P^c has been observed only among Baltis and in fact in the distribution of this system they show similarity with the Sunni Muslims of Jammu and Kashmir (Chahal et al., 1989). The low incidence of P^a and absence of P^c among both Bodhs and Tibetans of present study is in conformity with the pattern observed in other population groups with Mongoloid affinities such as Tibetans (Papiha et al., 1989) and Kanets (Papiha et al., 1984).

Adenosine deaminase (ADA) system

Among the present population groups of Ladakh, the frequency of gene ADA^2 was found less than 10 per cent (ranges from 4.67 per cent among Tibetans to 8.08 per cent among Baltis) which depicts their similarities with other population groups with Mongoloid affinities of Western Himalayas [Bodhs (Bhasin et al., 1983); Tibetans and Himachalis (Papiha et al., 1989)].

Adenylate kinase (AK) system

Table 2 shows that the frequency of gene AK^2 is quite low among the population groups of Ladakh (ranges from 1.41 per cent among Tibetans to 3.24 per cent among Bodhs), and this is in agreement with frequencies reported among population groups with Mongoloid affinities like Bodhs (Bhasin et al., 1983) and Kanets (Papiha et al., 1984) of Himachal Pradesh.

Esterase D (EsD) system

In the present study, Tibetans (37.85 per cent) are showing high frequency of gene EsD^2 followed by Bodhs (28.38 per cent), which depicts their similarities with the Kanet of Puh (Papiha et al., 1984) and Tibetans (Papiha et al., 1989). On the other hand, Baltis with comparatively low incidence of EsD^2 (23.23 per cent) are similar to population groups of middle and lower hills of Himalayas [Rajput (Chahal, 1981); Himachalis (Papiha and Nahar, 1977)] and Sunni Muslims of Jammu and Kashmir (Chahal et al., 1989).

Glucose phosphate isomerase (GPI) system

The rare gene GPI^3 was detected in each of the population groups of Ladakh — Bodhs (1.36 per cent), Baltis (2.02 per cent) and Tibetans (3.74 per cent). The Tibetans of present study are showing somewhat high frequency of GPI^3, though this gene was not detected among certain earlier reported samples from Western Himalayas (Papiha and Chahal, 1984; Papiha et al., 1989). The other two groups of present study are showing similarities with Gaddi-Brahmin (Chahal et al., 1982); Brahmin and Mahajan of Chamba (Chahal et al., 1991) and Gaddi - Rajputs (Papiha and Chahal, 1984).

Glyoxalase I (GLO I) system

In the present material, the Tibetans are showing the lowest frequency of GLO^1 gene (8.88 per cent) and such low frequency has also been observed among the Bhotias of Sikkim (Morpurgo et al., 1983). Bodhs and Baltis with little higher frequencies of this gene (15.68 and 18.18 per cent, respectively) are showing similarities with other population groups with Mongoloid affinities [Sherpas of Nepal (Saglio et al., 1979); Lepchas (Buddhists) (Saha et al., 1987)] but compared to Sunni Muslims of Jammu and Kashmir (Chahal et al., 1989), these estimates are lower.

Table 1: Distribution of red cell enzymes among population groups of Ladakh

Enzyme/ Phenotype	*Number Observed*		
	Bodhs	*Baltis*	*Tibetans*
AP			
A	11	12	4
BA	60	34	28
B	108	49	75
CA	0	0	0
CB	0	1	0
Total	179	96	107
ADA			
1-1	158	83	97
2-1	26	16	10
2-2	1	0	0
Total	185	99	107
AK			
1-1	173	94	104
2-1	12	5	3
2-2	0	0	0
Total	185	99	107
EsD			
1-1	95	58	43
2-1	75	36	47
2-2	15	5	17
Total	185	99	107
GPI			
1-1	179	95	99
3-1	5	4	8
Total	184	99	107
GLO I			
1-1	5	5	1
2-1	48	26	17
2-2	132	68	89
Total	185	99	107
PGM_1			
1-1	91	41	57
2-1	65	50	43
2-2	23	7	6
6-1	3	0	1
Total	182	98	107

Table 2 : Gene frequencies of red cell enzymes among population group of Ladakh

Enzyme/Gene	*Gene Frequency*		
	Bodhs	*Baltis*	*Tibetans*
AP			
P^a	22.91	30.21	16.82
P^b	77.09	69.27	83.18
P^c	0.00	0.52	0.00
Total	100.00	100.00	100.00
ADA			
ADA^1	92.43	91.92	95.33
ADA^2	7.57	8.08	4.67
Total	100.00	100.00	100.00
AK			
AK^1	96.76	97.47	98.59
AK^2	3.24	2.53	1.41
Total	100.00	100.00	100.00
EsD			
EsD^1	71.62	76.77	62.15
EsD^2	28.38	23.23	37.85
Total	100.00	100.00	100.00
GPI			
GPI^1	98.64	97.98	96.26
GPI^3	1.36	2.02	3.74
Total	100.00	100.00	100.00
GLO I			
GLO^1	15.68	18.18	8.88
GLO^2	84.32	81.82	91.12
Total	100.00	100.00	100.00
PGM_1			
PGM_1^1	68.68	67.35	73.83
PGM_1^2	30.50	32.65	25.70
PGM_1^6	0.82	0.00	0.47
Total	100.00	100.00	100.00

Phosphoglucomutase locus 1 (PGM_1) system

In the population groups investigated here from Ladakh region, the frequencies of the gene PGM_1^2 observed among Bodhs and Baltis are similar to that reported among Kanets (Papiha et al., 1984) and Tibetans (Santachiara - Benerecetti et al., 1976; Papiha et al., 1989) of Western Himalayas. Tibetans of present

study are showing comparatively low frequency of PGM_1^2 than that observed among the earlier reported samples (Santachiara Benerecetti et al., 1976; Papiha et al., 1989).

The rare gene PGM_1^6 encountered in Bodhs and Tibetans has also been reported among certain population groups like Pangwalas of Himachal Pradesh (Singh et al., 1982), Gurungs of Sikkim (Morpurgo et al., 1983) and Bhutanese (Mourant et al., 1968).

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