

FOR THE RECORD

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Allele Frequency of Eight Y-Chromosome STR Loci in Oriya Population of India

POPULATION: The present study involved 150 male individuals belonging to Orissa—a state on the eastern coast of India, representing four communities of the upper crust Hindu hierarchic caste system, namely, Oriya Brahmins, Karan, Khandayat, and Gope. The communities included in the study maintain a high degree of endogamy, as also evident from autosomal STR study (1,2).

KEYWORDS: forensic science, population genetics, DNA typing, Orissa, Brahmins, Karan, Khandayat, Gope, DYS19, DYS385, DYS389I, DYS389II, DYS390, DYS391, DYS392, DYS393, haplotype diversity

DNA was isolated from blood samples obtained from 150 healthy male individuals by standard phenol/chloroform procedure (3). Custom-made primers were labeled with 5'-FAM and JOE fluorescent dyes. PCR amplification for all the eight Y-STRs namely, DYS19, DYS385, DYS389I, DYS389II, DYS390, DYS391, DYS392, and DYS393, was carried out with a 25-ng template DNA in two multiplex reactions, standardized in the laboratory, using primers as described elsewhere (4,5). Amplified PCR products were run on a 5% polyacrylamide gel using a ABI 377 Automated DNA Sequencer. Sizing of the products was done using the ABI 377 Genescan Analysis Software version (3.1).

Analysis of Data

Alleles were designated according to the number of repeats (4–7). For each population, the allele frequencies were calculated by the simple gene count method. Gene and haplotype diversities for the eight Y-chromosomal STRs were calculated according to the Nei's formula (8).

$$h = n(1 - \sum x_i^2)/(n - 1)$$

where n represents the number of chromosome sampled, and x_i is the frequency of the i th allele or haplotype, using the software ARLEQUIN ver.2.0 (9).

Allele frequencies and gene diversities observed at the eight Y-chromosomal STRs among Oriya Brahmins, Karan, Khandayat,

and Gope along with the combined frequencies in populations of Orissa are given in Tables 1 to 3.

Gene diversity analysis suggests that Oriya population exhibits significant allele frequency variation. DYS391 was found to be the least polymorphic among all loci, with only Allele 10 being predominant in the studied samples. Gene diversity at individual loci for the rest of the markers varies from 0.602 for DYS19 to 0.938 for DYS385. At the population level, the Brahmins, which are at the upper most level of caste hierarchy, show comparatively less variation than the other communities. A triplicate allele pattern was observed for one of the Karan samples in DYS385 having the haplotype 9-13-14. Table 4 shows the distribution of Y-chromosomal haplotypes at eight microsatellites across Orissa populations. A total of 146 different haplotypes were found, 142 of them unique. Only one haplotype (H 68) was shared between Karan and Khandayat, with the other shared haplotypes being confined to their individual communities. The combined haplotype diversity, which is the same as PD value, across Orissa population is 0.9996 ± 0.0008 . The data generated show that the eight loci haplotype system is highly polymorphic and discriminative in Orissa population, thereby being extremely valuable for tracing the paternal lineage in population studies and human identification in forensic applications. The data of this study will also contribute to the expansion of Indian DNA database.

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TABLE 1—Allele frequencies and gene diversity value at microsatellite locus *DYS385* in Orissa population.

Allele Combination Observed	BR (n = 40)	KA (n = 39)	KH (n = 32)	GO (n = 39)	Combined Frequency
9-11	0.025		0.031	0.026	0.020
9-12	0.275	0.179	0.188	0.205	0.213
9-13	0.025	0.103			0.033
9-14	0.050				0.013
9-16	0.025				0.007
10-12	0.025	0.026	0.031	0.026	0.027
10-13	0.025	0.051		0.026	0.027
10-14	0.050	0.075			0.033
10-15	0.025			0.026	0.013
10-16		0.051		0.051	0.027
10-17		0.026		0.026	0.013
11-11	0.050				0.013
11-14	0.025			0.051	0.020
11-15	0.025		0.063	0.026	0.027
11-16	0.025	0.051	0.094	0.026	0.047
11-17	0.050	0.026	0.063	0.051	0.047
11-18	0.025				0.007
11-19			0.031		0.007
12-12				0.026	0.007
12-13		0.026	0.031	0.026	0.020
12-14		0.026			0.007
12-15	0.050		0.031		0.020
12-16		0.026	0.063	0.026	0.027
12-17	0.025	0.051	0.031	0.026	0.033
12-18			0.031		0.007
13-13				0.076	0.020
13-14		0.051	0.031	0.026	0.027
13-15	0.050	0.026	0.094	0.051	0.053
13-16	0.050	0.026	0.125	0.051	0.060
13-17	0.025	0.026		0.026	0.020
13-18		0.026		0.026	0.013
13-19		0.051	0.031		0.020
14-14	0.025	0.051			0.020
14-15	0.025			0.051	0.020
14-16	0.025			0.026	0.013
14-17				0.026	0.007
15-18			0.031		0.007
9-13-14		0.026			0.007
<i>h</i>	0.921	0.950	0.939	0.950	0.938

NOTE: BR = Brahmin; KA = Karan; KH = Khandayat; GO = Gope.

TABLE 2—Allele frequencies and gene diversity value at Y-chromosome STR loci in Orissa population (n = 150).

Alleles	DYS19					DYS389I					DYS389II				
	BR (n = 40)	KA (n = 39)	KH (n = 32)	GO (n = 39)	Combined Frequency	BR (n = 40)	KA (n = 39)	KH (n = 32)	GO (n = 39)	Combined Frequency	BR (n = 40)	KA (n = 39)	KH (n = 32)	GO (n = 39)	Combined Frequency
9						0.000	0.000	0.000	0.026	0.007					
10						0.150	0.154	0.093	0.128	0.133					
11						0.350	0.487	0.438	0.308	0.393					
12						0.500	0.359	0.469	0.538	0.467					
13	0.000	0.026	0.031	0.026	0.020										
14	0.275	0.205	0.188	0.230	0.227										
15	0.550	0.538	0.625	0.590	0.573										
16	0.150	0.154	0.125	0.128	0.140										
17	0.025	0.077	0.031	0.026	0.040										
18															
19															
20															
21															
22															
23															
24															
25															
26											0.100	0.128	0.031	0.129	0.100
27											0.100	0.359	0.313	0.230	0.247
28											0.325	0.179	0.313	0.308	0.280
29											0.325	0.155	0.313	0.230	0.253
30											0.100	0.179	0.031	0.103	0.107
31											0.050	0.000	0.000	0.000	0.013
<i>h</i>	0.614	0.654	0.574	0.596	0.602	0.621	0.626	0.0598	0.614	0.614	0.776	0.787	0.727	0.792	0.780

NOTE: BR = Brahmin; KA = Karan; KH = Khandayat; GO = Gope.

TABLE 3—Allele frequencies and gene diversity value at Y-chromosome STR loci in Orissa population (n = 150).

Alleles	DYS390					DYS391					DYS392					DYS393				
	BR (n = 40)	KA (n = 39)	KH (n = 32)	GO (n = 39)	Combined Frequency	BR (n = 40)	KA (n = 39)	KH (n = 32)	GO (n = 39)	Combined Frequency	BR (n = 40)	KA (n = 39)	KH (n = 32)	GO (n = 39)	Combined Frequency	BR (n = 40)	KA (n = 39)	KH (n = 32)	GO (n = 39)	Combined Frequency
9					0.013	0.000	0.026	0.000	0.026	0.013	0.000	0.026	0.000	0.026	0.013	0.000	0.026	0.000	0.026	0.013
10					0.800	0.825	0.844	0.794	0.794	0.800	0.125	0.000	0.000	0.000	0.033	0.125	0.000	0.000	0.000	0.033
11					0.180	0.175	0.156	0.154	0.180	0.180	0.375	0.128	0.280	0.205	0.247	0.375	0.128	0.280	0.205	0.247
12					0.007	0.000	0.000	0.026	0.007	0.007	0.350	0.692	0.594	0.538	0.540	0.350	0.692	0.594	0.538	0.540
13											0.000	0.026	0.063	0.040	0.040	0.000	0.026	0.063	0.040	0.040
14											0.075	0.077	0.063	0.154	0.093	0.075	0.077	0.063	0.154	0.093
15											0.050	0.077	0.000	0.026	0.040	0.050	0.077	0.000	0.026	0.040
16											0.025	0.000	0.000	0.000	0.007	0.025	0.000	0.000	0.000	0.007
17																				
18																				
19																				
20																				
21	0.100	0.026	0.156	0.000	0.067															
22	0.350	0.102	0.031	0.026	0.133															
23	0.050	0.154	0.094	0.282	0.147															
24	0.100	0.256	0.344	0.230	0.227															
25	0.150	0.154	0.125	0.103	0.133															
26	0.225	0.282	0.219	0.256	0.247															
27	0.025	0.026	0.031	0.103	0.047															
28																				
29																				
30																				
31																				
<i>t</i>	0.801	0.816	0.808	0.800	0.830	0.296	0.404	0.272	0.352	0.330	0.731	0.505	0.578	0.655	0.682	0.501	0.604	0.647	0.641	

NOTE: BR = Brahmin; KA = Karan; KH = Khandayat; GO = Gope.

TABLE 4—Distribution of Y-chromosomal haplotypes at eight microsatellites among Orissa population.

Haplotype	19	389I	389II	390	391	392	393	385	Oriya Brahmin	Karan	Khandayat	Gope	Total (N = 150)
H1	13	11	26	27	10	11	12	13				1	1
H2	13	11	27	24	10	11	14	17			1		1
H3	13	12	28	24	10	11	12	16		1			1
H4	14	10	26	22	10	14	14	14	1				1
H5	14	10	26	22	10	15	11	14	1				1
H6	14	10	26	22	10	16	11	15	1				1
H7	14	10	26	23	10	11	14	16		1		1	1
H8	14	10	26	23	10	12	12	16				1	1
H9	14	10	26	24	10	15	13	17				1	1
H10	14	10	26	24	10	15	14	17		2			2
H11	14	10	29	26	10	14	13	11	1				1
H12	14	11	26	22	10	12	14	15	1				1
H13	14	11	26	24	10	12	13	12				1	1
H14	14	11	27	23	10	11	14	16		1			1
H15	14	11	27	23	10	15	13	16	1				1
H16	14	11	27	24	10	11	13	14		1			1
H17	14	11	28	24	10	12	13	13		1			1
H18	14	11	28	24	10	12	13	16			1		1
H19	14	11	28	24	11	12	13	18		1			1
H20	14	11	28	27	10	14	13	15		1		1	1
H21	14	11	29	25	10	14	12	12					1
H22	14	11	29	26	10	13	13	16			1		1
H23	14	11	29	26	11	12	12	12				1	1
H24	14	12	27	24	10	11	14	16			1		1
H25	14	12	27	24	10	14	13	14				1	1
H26	14	12	28	21	10	10	14	16					1
H27	14	12	28	21	10	11	14	18					1
H28	14	12	28	21	10	11	14	17					1
H29	14	12	29	23	10	12	13	13				1	1
H30	14	12	28	24	10	11	14	16				1	1
H31	14	12	28	24	10	11	14	17			2		2
H32	14	12	29	24	10	11	14	17				1	1
H33	14	12	29	24	11	11	13	16			1		1
H34	14	12	29	25	10	12	13	14		1			1
H35	14	12	30	25	10	11	12	17					1
H36	15	9	27	26	10	12	13	11				1	1
H37	15	10	26	24	10	12	12	13		1			1
H38	15	10	26	25	10	12	13	15			1		1
H39	15	10	27	25	11	12	13	13-14		1			1
H40	15	10	27	25	11	13	13	14				1	1
H41	15	10	28	22	10	10	12	16					1
H42	15	10	28	23	10	12	11	15			1		1
H43	15	10	28	24	10	13	13	14		1			1
H44	15	10	28	26	11	15	14	15					1
H45	15	11	27	20	10	12	13	15			1		1
H46	15	11	27	21	10	12	13	15			1		1
H47	15	11	27	21	10	12	13	15			1		1
H48	15	11	27	22	10	12	13	14		1			1
H49	15	11	27	22	10	12	13	15					1
H50	15	11	27	22	10	12	14	13				1	1

continues

TABLE 4—Continued.

Haplotype	19	389I	389II	390	391	392	393	385	Oriya Brahmin	Karan	Khandayat	Gope	Total (N = 150)
H51	15	11	27	22	11	11	12	15	1				1
H52	15	11	27	23	10	11	12	15				1	1
H53	15	11	27	23	10	12	13	15				1	1
H54	15	11	27	23	10	12	13	13				1	1
H55	15	11	27	24	10	11	13	11		1			1
H56	15	11	27	24	10	11	14	10		1			1
H57	15	11	27	24	10	14	14	13			1		1
H58	15	11	27	25	10	11	13	17			1		1
H59	15	11	27	25	10	12	12	15			1		1
H60	15	11	27	25	10	12	11	15				1	1
H61	15	11	27	25	10	14	13	19		1			1
H62	15	11	27	25	10	14	15	19		1			1
H63	15	11	27	26	11	14	14	17		1			1
H64	15	11	28	21	10	12	12	15					1
H65	15	11	28	22	10	11	14	12					1
H66	15	11	28	25	10	11	11	11					1
H67	15	11	28	25	11	12	13	9					1
H68	15	11	28	26	10	12	13	12		1			2
H69	15	11	29	24	10	11	12	9		1			1
H70	15	11	29	26	10	10	13	14			1		1
H71	15	11	29	26	10	11	12	9		1			1
H72	15	11	29	26	10	12	13	9			1		1
H73	15	11	29	26	11	13	13	12			1		1
H74	15	12	27	24	9	12	13	14		1			1
H75	15	12	27	24	10	12	12	16			1		1
H76	15	12	27	24	10	13	13	12				1	1
H77	15	12	28	21	10	11	13	18				1	1
H78	15	12	28	22	10	11	12	16					1
H79	15	12	28	22	10	12	12	15					1
H80	15	12	28	23	10	12	13	16			1		1
H81	15	12	28	23	10	12	13	15		1			1
H82	15	12	28	23	10	11	12	14				1	1
H83	15	12	28	23	10	12	12	15			1		1
H84	15	12	28	23	10	12	14	15				1	1
H85	15	12	28	23	10	12	11	16				1	1
H86	15	12	28	23	10	12	12	16				1	1
H87	15	12	28	24	10	11	13	16			1		1
H88	15	12	28	24	10	12	13	14			1		1
H89	15	12	28	25	10	14	13	16				1	1
H90	15	12	28	26	10	14	14	18				1	1
H91	15	12	28	27	9	12	12	12				1	1
H92	15	12	29	21	11	12	13	16			1		1
H93	15	12	29	22	10	10	13	14		1			1
H94	15	12	29	22	10	12	12	16					2
H95	15	12	29	22	10	12	13	14		1			1
H96	15	12	29	23	10	11	13	9			1		1
H97	15	12	29	23	10	12	13	12					1
H98	15	12	29	23	10	12	15	10		1			1
H99	15	12	29	24	10	10	12	13					1
H100	15	12	29	24	11	12	13	12					1

TABLE 4—Continued.

Haplotype	19	389I	389II	390	391	392	393	385	Oriya Brahmin	Karan	Khandayat	Gope	Total (N = 150)
H101	15	12	29	25	10	11	13	9	1				1
H102	15	12	29	25	10	12	13	9			1		1
H103	15	12	29	26	10	12	13	9		1			1
H104	15	12	29	24	10	11	13	11				1	1
H105	15	12	29	24	10	11	14	11				1	1
H106	15	12	29	26	11	14	12	14				1	1
H107	15	12	29	27	10	12	14	13			1		1
H108	15	12	29	27	10	14	14	15					1
H109	15	12	30	26	10	11	13	9				1	1
H110	15	12	30	26	10	11	13	9	1				1
H111	15	12	30	26	10	12	12	9				1	1
H112	15	12	30	26	10	12	13	9		1			1
H113	15	12	30	26	10	12	13	10			1		1
H114	15	12	30	26	10	12	14	10				1	1
H115	15	12	30	26	10	12	14	9		1			1
H116	15	12	30	26	10	12	14	10		1			1
H117	15	12	30	26	11	12	13	9		1			1
H118	15	12	30	27	10	12	15	9		1			1
H119	15	12	31	26	10	12	13	9					1
H120	16	10	26	23	10	12	12	13				1	1
H121	16	10	27	22	10	12	12	13			1		1
H122	16	10	28	25	11	12	14	10				1	1
H123	16	11	27	22	11	12	12	13		1			1
H124	16	11	27	23	10	12	13	13		1			1
H125	16	12	27	24	10	11	13	11			1		1
H126	16	11	28	22	10	12	14	11					1
H127	16	11	28	26	10	12	13	9			1		1
H128	16	11	28	26	10	12	13	9		1			1
H129	16	11	28	26	11	12	13	9				1	1
H130	16	11	29	24	12	12	13	9				1	1
H131	16	11	29	26	10	12	12	9				1	1
H132	16	11	29	26	11	12	12	10					1
H133	16	11	29	26	11	12	13	9			1		1
H134	16	12	29	27	10	12	13	9					1
H135	16	12	30	25	11	12	13	9		1			1
H136	16	12	30	26	10	12	13	9					1
H137	16	12	30	26	11	11	13	9					1
H138	16	11	30	26	11	12	13	9					1
H139	16	12	30	26	11	14	13	9				1	1
H140	16	12	31	26	10	12	13	9					1
H141	17	11	26	25	10	12	13	9		1			1
H142	17	11	27	21	10	12	12	12					1
H143	17	12	27	22	11	12	13	10					1
H144	17	11	28	26	11	12	14	9				1	1
H145	17	11	29	25	11	12	13	9					1
H146	17	12	29	23	11	11	12	9			1		1
<i>h</i>									0.9987 ± 0.0060	0.9987 ± 0.0062	0.9980 ± 0.0085	1.000 ± 0.0085	0.9996 ± 0.0008

NOTE: Haplotype frequencies are given in absolute numbers.

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