

A genetical study of the five tribal groups of Andhra Pradesh, India

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With 1 figure and 5 tables in the text

Summary: 846 blood samples belonging to 5 tribal groups of Adilabad district of Andhra Pradesh, namely, Naikapod (53), Koya (200), Rajgond (121), Kolam (331) and Pardhan (141), were tested for 10 serological and biochemical marker systems: AB₀, MN and Rh(D) blood groups, Hp, Cp, Tf, PGM₁, Ac ph, Est-D and LDH. The range of A group is 33.00 % to 39.22 %, highest percentage of B group is in the Pardhans (44.68 %). Highest gene frequency is amongst the Naikapods (0.6054). The Rh(D)-ve is observed in the whole population, the highest occurrence is in the Rajgonds (6.18 %). There is complete absence of Hp 1—1 type, and the maximum Hp¹ gene is found in the Koyas (0.1073). Only one CD transferrin variant is noticed. The maximum p^a allele of Ac ph (about 20 %) is present in the Kayas and Rajgonds. No variant for PGM₁, Est-D, LDH is found. The results are discussed, with the available informations of other Indian populations.

Zusammenfassung: Es wurden 846 Blutproben aus folgenden fünf Stammesgruppen des Distrikts Adilabad, Andhra Pradesh, untersucht: Naikapod (53), Koya (200), Rajgond (121), Kolam (331), Pardhan (141). Folgende Bluteigenschaften wurden bestimmt: AB₀, MN und Rh(D), Hp, Cp, Tf, PGM₁, Ac ph, Est-D und LDH. Die Häufigkeit der Blutgruppe A schwankt zwischen 33,0 bis 39,2 %. Der höchste Anteil von B findet sich bei den Pradhans mit 44,7 %, der höchste Anteil von Rh(D) bei den Rajgonds (6,2 %). Hp 1—1 fehlt völlig, und die höchste HP 1-Genfrequenz findet sich bei den Koyas (0,1073). Nur eine CD-Transferrinvariante konnte festgestellt werden. Die größte Häufigkeit des p^a-Allels von Ac ph (über 20 %) findet sich bei Kayas und Rajgonds. Für PGM₁, Est-D, LDH fanden sich keine Varianten. Die Ergebnisse werden im Zusammenhang mit den vorliegenden Befunden für andere indische Bevölkerungen diskutiert.

There are about 427 tribal groups in India (ROY BURMAN, 1971) which comprise nearly 6.94 % of the total population of India. In Andhra Pradesh the number of tribal groups is about 34 (Census of India, 1961) and the total tribal population is about 1,657,657 which is almost 3.81 % of the total population of the state (Census of India, 1971). The study of the tribal population is important in the context of India's typical caste system. Very little information is available regarding various genetic components of these tribal groups. In the present study an attempt has been made to investigate the distribution of ten serological and biochemical markers in five tribal groups of Andhra Pradesh.

The investigation was carried out in 1973—74 amongst the following tribes: Naikapod (53), Koya (200), Rajgond (121), Kolam (331), and Pardhan (141). These tribes belong to Adilabad district, which is situated in the northern part of the state (Fig. 1) and these tribes morphologically and culturally are classified as proto-Australoid.

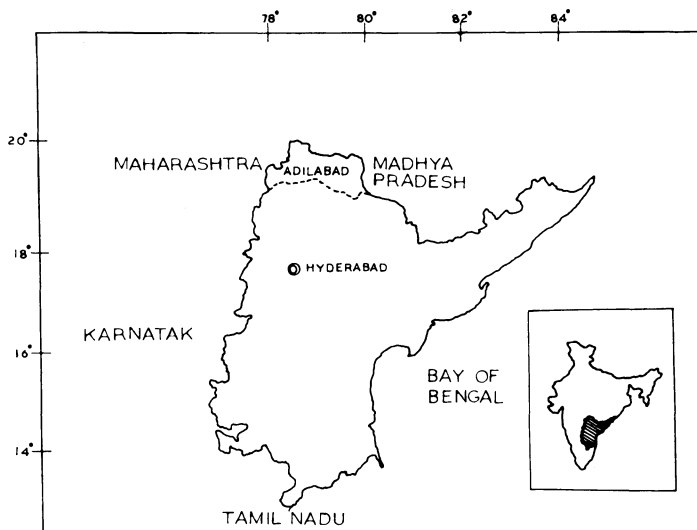


Fig. 1. Map of Andhra Pradesh showing the distribution of tribal groups under survey in Adilabad district. Inset: Map of India with reference to Andhra Pradesh.

Socio-cultural background of the tribes

The Rajgonds, Kolams and Pardhans are three major populations residing in Utnor taluka which forms the south-eastern end of an extensive area of black cotton soil (Deccan traps) spread throughout the major portion of Maharashtra state. The Koyas and Naikapods live in the adjacent area of Gondwana land consisting of sandy loomy soil.

All these tribes live in the area which was endemic for malaria. The staple crop for these tribes is sorghum, though, the Koyas and Naikapods subsist on a mixed cereal diet of sorghum and rice. The Koyas are a major group being approximately 200,000 in number in the state. The Rajgonds are also a larger group in the state than the Kolams and Pardhans numbering about 143,000. The Naikapods are a smaller group living mostly in north-eastern part of the state. The Rajgonds and Kolams speak a Dravidian language and due to cultural and linguistic similarities between them, some anthropologists consider the Kolams to be an offshoot of the Rajgonds (RUSSEL & HIRALAJ, 1916). The Koyas and the Naikapods speak Telegu and practise settled agriculture. The Pardhans speak Marathi as well as Gondi. In Maharashtra, the Pardhans are classified as an "untouchable" caste.

All these tribes practise consanguineous marriages. The Rajgonds, Kolams and pardhans have a high frequency of first cousin marriages and the average inbreeding coefficients are 0.021, 0.028 and 0.032, respectively (PINGLE, 1975). The average inbreeding coefficient in Koyas of East Godavari is also very high (VEERARAJU, 1973).

Materials and methods

A total of 846 blood samples were collected by finger prick from each individual and were tested for AB0, MN and Rh(D) blood groups; serum proteins: haptoglobin, transferrin, and ceruloplasmin; and enzyme systems: phosphoglucosmutase at locus 1, acid phosphatase, esterase-D and lactate dehydrogenase.

The blood groups were done by standard techniques. The sera used were supplied by "Dade" reagent, U. S. A. Horizontal starch gel electrophoresis technique was followed for serum protein and enzyme systems according to earlier workers as follows: for Hp, Cp and Tf the method of ASTON & BRADEN (1961), for Ac ph the method of KARP & SUTTON (1967), for PGM₁ the technique of DAS et al. (1970), and for LDH BLAKE et al. (1969) and Est-D the method of HOPKINSON et al. (1973) was followed.

Results

Blood group

AB0 system: The results of AB0 blood groups are given in Table 1. Frequency of A phenotype is relatively higher amongst the Naikapods, Koyas and Rajgonds (range 33.00 % to 39.22 %). Phenotype B is more frequent among the Kolams (42.29 %) and Pardhans (44.68 %). The p gene ranges from 0.1565 (Pardhans) to 0.2912 (Rajgonds) and the q gene ranges between 0.1364 (Naikapods) and 0.3219 (Kolams) whereas the r gene varies between 0.4812 (Kolams) and 0.6054 (Naikapods).

MN system: Table 2 presents the distribution of MN blood groups in the populations. Sample size of Kolams and Pardhans for MN and Rh(D) blood groups were small and have been excluded from any comparison. M phenotype is maximum in the Koyas (64.50 %), while the frequency of N type is highest amongst the Naikapods (16.99 %) with a corresponding maximum n gene frequency (0.3302).

Rh(D) group: Rh(D) negative, (dd), is present in all these populations and the highest frequency (6.18 %) of it is observed amongst the Rajgonds (Table 2).

Serum proteins

Haptoglobin: Table 3 gives the distribution of Hp type; with small sample sizes for Kolams and Pardhans. It is very much striking to note the complete absence of phenotype Hp 1—1 in all these tribes, exhibiting a very low frequency of Hp¹ gene. The maximum (0.1073) frequency of Hp¹ is found in the Koyas (Kolams and Pardhans, owing to small sample sizes, are not considered).

Transferrin: In Table 3 the distribution of Tf types are shown for the Koyas. Except for one case of CD variant, all the samples are of CC type.

Ceruloplasmin: In Table 3 the sample sizes of Naikapods and Koyas are also given and in all the cases the Cp types are normal BB.

Table 1. AB0 blood group distribution in 5 tribal groups in Andhra Pradesh.

Population	MN system				Gene frequency with S. E.		Rh(D) No. tested	Rh+ve	Rh-ve	Gene frequency with S. E.
	No. tested	Phenotypes		N	χ^2	I D. F.				
		M	N							
Naikapod	53	27	9	17	0.3302	4.004	52	50	2	0.1961
		50.94	16.99	32.07	± 0.4560			96.25	3.85	± 3.5355
Koya	200	129	7	64	0.1950	0.074	200	194	6	0.1732
		64.50	3.50	32.00	± 0.0198			97.00	3.00	± 6.9641
Raj Gond	102	56	12	34	0.2843	3.339	97	91	6	0.2487
		54.90	11.76	33.34	± 0.0315			93.82	6.18	± 4.7697
KoLam	27	17	0	10	0.1851	1.395	27	26	1	0.1924
		62.96	0.00	37.04	± 0.0528			96.30	3.70	± 2.5495
Pardhan	27	5	6	16	0.5185	0.942	27	25	2	0.2721
		18.52	22.22	59.26	± 0.0679			92.60	7.40	± 2.5000

Table 2. MN and Rh(D) blood group distribution in 5 tribal groups in Andhra Pradesh.

Population	No. tested	Phenotypes			Gene frequencies with S. E.							
		O	A	B	AB	p	q	r	a	χ^2	I D. F.	
Naikapod	53	20	19	9	5	0.2582	0.1364	0.6054				
		37.73	35.85	16.99	9.43	± 0.0468	± 0.0038	± 0.0470				0.0722
Koya	200	59	66	60	15	0.2308	0.2114	0.5578				
		29.50	33.00	30.00	7.50	± 0.0225	± 0.0021	± 0.0226				1.7217
Raj Gond	121	21	40	31	10	0.2912	0.2230	0.4858				
		20.59	39.22	30.39	9.80	± 0.0351	± 0.0037	± 0.0353				2.2224
KoLam	331	74	79	140	38	0.1969	0.3219	0.4812				
		22.36	23.87	42.29	11.48	± 0.0163	± 0.0017	± 0.0164				0.8533
Pardhan	141	38	33	63	7	0.1565	0.2957	0.5478				
		26.95	23.40	44.68	4.97	± 0.0228	± 0.0021	± 0.0229				4.4632

Enzymes

Acid phosphatase: The distributions of Ac ph types are given in Table 4. Common phenotypes A, B and AB are found in all the tribes except Pardhans. The p^a gene is present with a frequency of about 20% in the Koyas and Rajgonds.

Phosphoglucomutase at locus 1: Koyas, Rajgonds and the Kolams were tested for PGM_1 , and three common phenotypes were noticed and are shown in Table 5. Rajgonds samples are not considered due to small number. PGM_1^2 gene frequency is found to be about 0.25 in the Koyas.

Table 3. Haptoglobin, transferrin and ceruloplasmin distribution in 5 tribal groups of Andhra Pradesh.

Population	Haptoglobin			Transferrin			Gene frequency with S. E.	Gene frequency with S. E. T _{FD}		
	No. tested	Phenotypes		Gene frequency with S. E. Hp ¹	Gene frequency with S. E. χ^2 1 D.F.	No. tested			Phenotypes	
		1-1	2-1						2-2	CC
Naikapod	52	0	8	44	0.0769 ±0.0261	0.361	-	-	-	
Koya	177	0	38	139	0.1073 ±0.0164	2.560	90	89	1	
Raj Gond	73	0	10	63	0.0684 ±0.0209	0.395	-	98.88	1.12	
Kolam	22	0	8	14	0.1818 ±0.0581	1.086	-	-	-	
Pardhan	20	0	1	19	0.0250 ±0.0246	0.013	-	-	-	
<u>Ceruloplasmin</u>										
52 samples of Naikapod and 153 samples of Koya were tested for ceruloplasmin and all were Normal Cp, no variant was detected.										

Esterase-D: Only 50 samples of Koyas could be tested for Est-D showing phenotypes 1—1, 2—1 and 2—2 which are shown in Table 5.

Lactate dehydrogenase: All the 5 tribal groups were tested for LDH and the distributions are given in Table 5. No variant could be detected in any of the groups.

Discussion

Our present findings about AB0 blood groups are compared with the available data on the Indian tribal populations including Andhra Pradesh, of various racial composition

Table 4. Acid phosphatase and lactate dehydrogenase distribution in 5 tribal groups of Andhra Pradesh.

Population	Acid phosphatase				Gene frequency with S. E.		Lactate dehydrogenase		
	No. tested	Phenotypes		with S. E.		No. tested	Phenotypes		
	A	B	AB	χ^2 1 D.F.			Normal	Variant	
Naikaped	—					45	45	0	
Koya	74	8 10.81	51 68.92	15 20.27	0.2094 ± 0.0334	1.136	201	0	
Raj Gond	59	4 6.78	39 66.10	16 27.12	0.2033 ± 0.0370	1.570	118	0	
Kolam	13	3 23.08	6 46.15	4 30.77	0.3846 ± 0.0954	1.592	29	0	
Pardhan	23	0 0.00	20 86.96	3 13.04	0.0652 ± 0.0364	0.112	35	0	

Table 5. Phosphoglucomutase at locus 1 and esterase-D distribution in 3 tribal groups in Andhra Pradesh.

Population	Phosphoglucomutase				Gene frequency with S. E.		Esterase-D				
	No. tested	Phenotypes		with S. E.		No. tested	Phenotypes				
		1-1	2-2	2-1	χ^2 1 D.F.		1-1	2-2	2-1		
Koya	160	95 59.37	15 9.38	50 31.25	0.2500 ± 0.0242	4.444	50	13 26.00	7 14.00	30 60.00	0.4400 ± 0.4960
Raj Gond	26	12	7	7	0.4038 ± 0.0680	3.053					
Kolam	11	7 63.64	1 9.09	3 27.27	0.2272 ± 0.0893	0.550					

and location. In Andhra Pradesh a number of tribal groups have been studied for ABO blood groups. The value of p gene amongst the Andhra tribal groups ranges from 0.094 (Yenadi by REDDI) to 0.293 (Bagatha by RAO & REDDI, 1973), though the lowest value is found amongst the Bhils of Aurangabad (0.084, MACFARLANE, 1940), but due to small

sample size (44) this value may not be considered; moreover, when this value of Bhils is compared with Bhils of other places like of Maharashtra (MUKHERJEE et al., 1979), it is found much higher (0.196—0.208). The *p* value of the present study lies within the above range. The *q* gene value in our findings seems to be the highest amongst Andhra tribal populations (0.3219 in Kolam) in comparison to other Andhra tribes and the range is 0.152 (Konda Reddi, POORNIMA, 1971), to 0.297 (Lambadi, RAMCHANDRIAH, 1967). The values of *r* gene of the present study lie within the range of other Andhra tribal groups: 0.472 (Bagatha) to 0.736 (Yenadi). When the distributions of ABO blood groups in other Indian tribal groups are taken in account, it is found that the *p* gene may be totally absent amongst certain tribes like the Kotas of Nilgiri hills and Nayadis of Malabar area (by LEHMAN & CUTBUSH, 1952, and AYAPPAN, 1939, respectively). A very low frequency of *q* gene is observed amongst the Nicobarese (about 5 %) by SARKAR (1952) and Comorta tribe of Nicobar island (about 3 %) by AGRAWAL (1964). The highest *r* gene frequency is noticed among the Kanikkars of Kerala (0.814 by BUCHI, 1953) and Carmorta of Nicobar island (0.846 by AGRAWAL, 1964).

The incidence rate of Rh negative (*dd*) varies from 0 to about 13 % in the Indian tribal populations. A number of tribal groups like Riang of Tripura (KUMAR & SASTRY, 1961), Ho and Munda of Ranchi (by BHATTACHARJEE, 1969), Bado Gadaba, Parang godaba and Konda Paroga of Orissa (by DAS et al., 1966, 1966), Khasis of Assam (by MIKI et al., 1960), Irula and Paniyan of Tamilnadu (by LEHMAN & CUTBUSH, 1952) and Santal of West Bengal (by CHAUDHURY et al., 1967) do not show any Rh negative incidences. The highest percentage of Rh negative (12.35 %) is found amongst the Toda of Nilgiri by KIRK et al. (1962). The present findings of Rh negative occurrence lie within this wide range of variation. Incidentally, GOUD (1976) did not observe any Rh(D) negative amongst the Nainkappods and Pardhans of Andhra Pradesh.

Only a few studies are available regarding biochemical markers amongst the Indian tribal groups (MUKHERJEE et al., 1975; SAHA et al., 1974, 1976). For the acid phosphatase system the *p^a* gene ranges between 0.035 to 0.281 (Irula and Kurumba by SHAH et al., 1976) and the findings here lie almost within this range except Kolam (0.3846). Only two cases of BC phenotype were observed amongst the Kadars of Kerala by SHAH et al. (1974), though *p^c* gene has been detected amongst some non-tribal populations like Bengali Hindus and Kaoras of W. Bengal, (DAS et al., 1970, 1973).

Three common phenotypes at PGM₁ locus are observed in all the tribal populations in India so far studied. SHAH et al. (1974, 1976) noticed a low range of PGM₁ gene among the Kurumba (0.442) to Malayarayan (0.610), whereas in the present study a very high incidence of PGM₁ in the Koyas (0.750) is noticed, which is comparable with the Oraons of Bihar (0.684) by MUKHERJEE et al. (1975). Rare alleles like PGM₁^{6Mal} (0.076) and PGM₁⁶ (0.021) in the Malayarayans and Kadars were detected by SAHA et al. (1974, 1976).

In Indian populations the LDH isozyme patterns appear to be polymorphic and the tribal groups are also no exception (7 % LDH Cal-1 present in Kurumba, 3.29 % in Kadar, 0.6 % in Irula [by SAHA et al., 1974, 1976], Munda 1.60 % and Oraon 2.24 % [by MUKHERJEE et al., 1973, 1975]). But in the present study there is total absence of LDH variant which seems to be quite interesting. GOUD (1975) also did not observe a single LDH

variant amongst the Rajgonds, Koyas, Pardhans and Naikapods in the same area. No comparable study for esterase-D-enzyme system on the other Indian tribes is available.

Some data about the distribution of serum haptoglobin types in the tribal groups of India are available. The incidence rate of Hp¹ allele varies from 0.3523 (Toda by KIRK & LAI, 1962) to 0.0592 (Irula by SAHA et al., 1976). The Hp¹ gene distributions in this study also fall within this range (except Pardhan whose sample size is very small). A very low frequency of Hp¹ gene is one of the characteristics of the low caste and tribal populations of India. GOUD (1975) observed absence of Hp 1—1 type in the Koyas and Pardhans and a very high frequency of Hp0 (between 1.23 to 12.07) amongst Koyas, Pardhans, Rajgonds and Naikapods in the above area. In this study not a single case of Hp0 was detected.

Most of the Indian populations tested for transferrin types are invariant with some sporadic occurrence of Tf^{B₂}, Tf^D and Tf^{D^{chi}}. The Oraons of Ranchi tested by KIRK et al. (1961) and MUKHERJEE et al. (1975) exhibited Tf^{D^{chi}} (0.032) and Tf^D (0.048), respectively. In the present data one case of CD variant amongst the Koyas has been detected. Further work on Kolams, Rajgonds and Koyas from the same area show a number of incidence of CD variant (by PINGLE, unpubl.). GOUD (1975) noticed a polymorphic character of Tf^{CD^{chi}} variant in the Naikapods and Koyas (about 6.67% to 9.09%).

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