

Absence of A Blood Group in an Endogamous Population of Andhra Pradesh

N. Lakshmi, P. Veerraju and T. Venkateswara Rao

Department of Human Genetics, Andhra University, Visakhapatnam 530 003, Andhra Pradesh, India

KEY WORDS Thrivarnikas. Absence of A Blood Group. Founder Effect. Drift.

ABSTRACT Complete absence of A blood group was observed in Thrivarnika an endogamous population. This may be due to founder effect followed by drift.

INTRODUCTION

Although first discovered a century ago, the ABO blood group system continues to allure the attention of geneticists even today. It is one of the most important category of genetic traits in man, as this system was helpful to demonstrate several principles in human genetics such as multiple allelic theory, Hardy Wienberg law etc. and was useful in linkage analysis. It is also used as one of the principal markers that helps appropriate decision making in blood transfusion, tissue transplantation and the treatment of hemolytic disease of new-born. The ABO locus which has been assigned to the distal end of the long arm of chromosome 9 (9q34) is also said to be associated with some diseases (Mourant et al., 1978) implying the role of selection and certain studies also used ABO blood groups in demonstrating other evolutionary forces like Founder effect and drift (Glass et al., 1952).

In 1990s, the molecular level studies on ABO blood groups were conducted (Yamamoto et al., 1990) and seven nucleotide sequence differences are found between the A and B alleles. The O allele has a single base pair deletion (258 – Gua) in the ABO gene coding region, which indicates the lack of transferase activity in the O individuals due to frameshift mutation. Thus, the ABO polymorphism, discovered by Landsteiner in 1900, was finally elucidated at molecular level only 90 years later.

Hundreds of endogamous groups have been studied for ABO covering different geographical regions of the country, and broad pattern of

ethnic and geographic patterns derived using the published data (Majumder and Ray, 1982; Bhasin et al., 1994). However the studies at understanding microevolutionary dynamics among the endogamous sub populations of a caste or region are few (Karve and Malhotra, 1968; Malhotra, 1978).

While the gene pools of most of the populations contain all the three alleles *A*, *B* and *O* in some frequency or the other, very few populations exhibit only two of the three alleles. Such populations help in understanding microevolutionary dynamics. In this paper we present one such endogamous population, rather a subpopulation the Thrivarnika, a subpopulation of Vysya. We also make an attempt to provide the frequencies of ABO blood groups from different regions of the State, to review linguistic/geographic differences, based on published data.

MATERIALS AND METHODS

A total of 101 blood samples from Arya Vysya, 100 samples from Kalinga Vysya and 101 samples from Thrivarnika were collected. Both Kalinga Vysya and Thrivarnikas were studied for the first time while Arya Vysyas were studied earlier, but only from other areas of Andhra Pradesh (Gopalam and Rao, 1981; Char et al., 1989). Samples were collected from unrelated adults. Subjects were chosen from three North Coastal districts of Andhra Pradesh namely Visakhapatnam, Vizianagaram and Srikakulam districts.

Antisera, marketed by, Ortho Diagnostic systems a division of Ethnor Limited, Bombay were used, following standard methods.

RESULTS AND DISCUSSION

Frequency distribution of phenotype and

Table 1: Frequency distribution of ABO blood groups in three endogamous Vysya populations

Population	No.	No. and % of phenotypes				Allele Frequency		
		A	B	AB	O	A	B	O
Arya Vysya	101	8	35	0	58	0.0408	0.1936	0.7655
		7.92	34.65	0	57.43	$\chi^2 = 0.2403$.50>P>.70
Kalinga Vysya	100	1	30	1	68	0.0098	0.1687	0.8216
		1.00	30.00	1.00	68.00	$\chi^2 = 0.0333$.80>P>.90
Thrivarnika	101	0	42	0	59	0.0000	0.2357	0.7643
		0	41.58	0	58.42			

allele frequencies of ABO blood groups are given in table 1. Among all the three populations 'O' is the most predominant blood group. Frequency of A group is either negligible as in Arya Vysya and Kalinga Vysya or virtually absent as in Thrivarnika. The Arya Vysya and Kalinga Vysya populations are in Hardy-Wienberg equilibrium. In the case of Thrivarnika, it could not be tested for Hardy-Wienberg equilibrium as it is not possible to identify heterozygote. The most conspicuous and curious observation is the absence of A allele in the Thrivarnika. Absence of A allele was earlier reported in three more populations in India (Table 2).

The history of the Thrivarnika would be helpful in understanding the dynamics of the absence of A allele among them.

In the fourfold caste hierarchy of the Hindu religion Brahmin, Kshatriya, Vysya and Sudra, the Vysyas are the third. They are referred as Arya Vysya in Andhra Pradesh. It is one of the few ancient Hindu castes from the historical point of view. They are traders by profession. In general, they follow Brahmins, the priestly caste, in most of their customs. They are vegetarians

by diet. Consanguineous marriages are common among them. They worship all Hindu deities belonging to both Vaishnavite and Saivite sects.

The Kalinga Vysya and Thrivarnika, who are not mentioned in the ancient caste classification are also traders but non-vegetarian. While the Arya Vysya and Kalinga Vysya are general traders, the Thrivarnika patronise the business of precious metals gold and silver. Kalinga Vysyas habitate in the old Kalinga country which extended through the border districts of present Andhra Pradesh and Orissa states. Their number runs in several thousands. They also prefer consanguineous marriages. Marriage between Arya Vysya and Kalinga Vysya is usually avoided. They also worship all Hindu Gods and Goddesses belonging to both sects.

Thrivarnikas follows Brahminical customs more scrupulously than the two other groups. They can be identified with their facial markings known as 'Namam' (Vaishnava symbol). They consider themselves next to Arya Vysya. They worship only Sri Maha Vishnu, his consort and their incarnations but not Lord Siva. They claim that their population is only about five thousand in the country. They are generally

Table 2: Complete absence of a allele in Indian populations

Population	Number	Allele Frequency			Reference
		A	B	O	
Andhra Pradesh					
Thrivarnikas (Visakhapatnam)	101	0.00	23.57	76.43	Present Study
Kerala					
Nayadis (Malabar)	50	0.00	47.08	52.91	Aiyappan, 1939
Tamil Nadu					
Kotas (Nilgiri hills)	86	0.00	29.30	77.70	Lehman and Cutbush, 1952
Great Nicobar, Daccaia, Dakadas, Putha, Tatai					
Shompen	55	0.00	0.00	100.00	Agarwal, 1966

found in few pockets of Chennai of Tamilnadu state and Vizianagaram, Visakhapatnam, Rajahmundry, Kakinada and Warangal of Andhra Pradesh.

Sherring (1881) suggested that the three Vysya populations of the present study populations belong to one common stock, despite the present state of differentiation into three separate endogamous groups. Regarding the origin of Thrivarnikas, they claim that their community came into existence, during the time of the great Vaishnava reformer "Sri Ramanujacharya" of 11th century A.D. They say that those among the Arya Vysya who accepted the doctrine of Visisthadvaita are called Thrivarnikas. Another version is that a Srivaishnava Brahmin married

a Vysya girl and their progeny was later referred to as Thrivarnika.

In spite of various theories about the three Vysya castes, it can be safely assumed that they are the sub populations of the main stock Vysyas described in the traditional four fold caste system. As already mentioned Thrivarnikas are the latest group among the three and came into existence in 11th century A.D. under the influence of Sri Ramanujacharya. Therefore, it can be safely assumed that they are separated from the Arya Vysya among whom the frequency of blood group A is very low and the total absence of A among the newly formed sub population Thrivarnika is due to 'Founder effect'.

An attempt is made to compare the Vysya of

Table 3: ABO blood groups among the Vysyas from different parts of India

Region	Population	No.	Allele Frequency			Reference
			A	B	O	
Coastal Andhra Pradesh	Arya Vysya	101	4.09	19.36	76.55	Present Study
	Kalinga Vysya	100	0.98	16.87	82.16	Present Study
	Thrivarnikas	101	0.00	23.57	76.43	Present Study
Visakhapatnam	Vaisyas	108	4.30	18.70	77.00	Rajani Kumari and Rao, 1986
Rayalaseema (Tirupati)	Vysyas	102	8.80	20.35	70.85	Reddy et al., 1980
Telangana	Vysyas	721	2.67	20.00	77.33	Gopalam and Rao, 1981
North India						
Haryana	Bania Agarwal	244	16.10	25.71	58.19	Shivaraman et al., 1971
Delhi Hospitals	Bania Gupta	310	16.36	25.99	57.65	Shivaraman et al., 1971
Punjab	Bania	112	14.59	27.09	58.31	Sehgal et al., 1986
Uttar Pradesh						
Lucknow	Rastogi	200	15.20	36.12	48.68	Rastogi and Tyagi, 1975
North India	Banias	500	12.36	28.06	59.55	Agarwal and Bhalla, 1981
West India						
Gujarat	Vania Soni	267	19.29	24.78	55.93	Undevia et al., 1978
Maharashtra						
Nagpur	Maheswaris	172	12.65	25.91	61.44	Gandhi, 1988
Pune	Maheswaris	155	12.65	29.25	58.10	Gandhi, 1988
West India	Kapol Vania	200	26.32	11.88	61.80	Vyas et al., 1958
East India						
Assam	Baishya	302	15.30	16.00	68.70	Das and Deka, 1985
Calcutta	Vaidyas, Vaisyas Hindus (Patients)	6247	17.26	25.00	57.74	Das Gupta and Chatterjee, 1955
Central India						
Madhya Pradesh (Dhar, Bagh, Badnarwar)	Jain and Vaishya	100	16.02	23.61	60.37	Kumar, 1966
Mandsaur, Ratlam	Jain and Vaishya	86	15.60	19.80	64.60	Kumar, 1965
Ujjaini district	Jain and Vaishya	56	17.64	20.96	61.40	Kumar and Ghosh, 1967
Mehidpur, Ujjain						
South India						
Tamil Nadu	Chettis	342	12.09	19.71	68.20	Ayer and Mummurthi, 1953
Pondicherry	Chettiyers	102	8.09	26.99	64.92	Banerjee et al., 1988
	Vsyas	105	7.06	21.98	70.96	Banerjee et al., 1988

present study with other Vysya populations from Andhra Pradesh and different parts of India (Table 3). The range of *A* allele frequency varies from 2.67% to 26.32% (Lakshmi, 1994; Veerraju et al., 1997). The frequency of allele *A* while absent among the Thrivarnika, is also lowest among the Kalinga Vysya. It is interesting that this is the only Telugu group studied that does not show the presence of *A* blood group.

It may also be pertinent to note that higher *B* allele frequencies than that of *A* are reported not only among the Vysya groups of the present study but also other Vysya groups from other parts of Andhra Pradesh. This may suggest that Vysyas probably represent one of the ancient stocks descended from autochthonous population of India which record the predominance of *B*, with relatively low rate of admixture.

The cluster analysis of the genetic distances based on eight genetic markers and the UPGMA tree (Lakshmi, 1994) indicates that the three Vysyas stand distinctly away from the rest of the seventeen Andhra Populations. This confirms the distinctness and endogamous nature of these three groups compared to rest of the populations. Among these three groups the Thrivarnika fall apart from the other two populations. This is in accordance with the expected pattern as they are small in size, practice high consanguinity and acquired the status of a genetic isolate by exhibiting the total absence of *A* allele for the ABO system, lending further support to the theory of Founder effect.

REFERENCES

- Agarwal, S. and Bhalla, V.: Serological differences among the three north Indian caste groups. *Ind. J. Phys. Anthropol. Hum. Genet.*, **7**: 135-146 (1981).
- Agarwal, H.N.: A study on ABO blood groups, PTC taste sensitivity, sickle cell trait and middle phalangeal hair among the Burmese immigrants of Andamans Islands. *East. Anthropol.*, **19**: 107-116 (1966).
- Aiyappan, A.: Blood groups of the Pre-Dravidians of the Wyand Plateau, India. *Man*, **39**: 200 (1939).
- Ayer, A.A. and Mummurthi, C.: Distribution of O, A, B and AB blood groups in the major South Indian communities. *J. Anat. Soc. India*, **2**: 6-12 (1953).
- Banerjee, S., Roy, M., Dey, B., Mukherjee, B.N. and Bhattacharjee, S.K.: Genetic polymorphism of red cell antigen, enzyme, haemoglobin and serum protein in fifteen endogamous groups of South India. *J. Ind. Anthropol. Soc.*, **23**: 250-259 (1988).
- Bhasin, M.K., Walter, H. and Danker Hopfe, H.: *The Distribution of Genetical, Morphological and Behavioural traits among the Peoples of Indian Region*. Kamla-Raj Enterprises, Delhi (1992).
- Bhasin, M.K., Walter, H. and Danker-Hopfe, H.: *People of India: An Investigation of Biological Variability in Ecological, Etho-economics and Linguistic Groups*. Kamla-Raj Enterprises, Delhi (1994).
- Char, K.S.N., Lakshmi, P., Gopalam, J., Sastry, J.G. and Rao, P.R.: Genetic differentiation among some endogamous populations of Andhra Pradesh, India. *Am. J. Phys. Anthropol.*, **78**: 421-429 (1989).
- Das, B.M. and Deka, R.: Population Study in Assam: ABO blood groups, haemoglobin E and G-6-PD deficiency. *Anthropol. Anz.*, **43**: 81-86 (1985).
- Dasgupta, C.R. and Chatterjee, J.B.: ABO blood group distribution in Indians. *Bull. Calcutta Sch. Trop. Med.*, **3**: 125-126 (1955).
- Gandhi, L.P.: Genetic Structure of Maheswaris. In: *Current Anthropological and Archaeological Perspective*. Volume I. Man, K.L. and Bhowmik (Eds.). Delhi, India Publications pp. 259-274 (1988).
- Glass, B., Sacks, M.S., Jahn, B.F. and Hess, C.: Genetic drift in a religious isolate: An analysis of the causes of variation in blood group, and other gene frequencies in a small population. *Am. Naturalist*, **86**: 145-159 (1952).
- Gopalam, K.B. and Rao, P.R.: Genetic studies on Vysyas of Andhra Pradesh, S. India: A1A2BO, Rh(D), transferrin, group specific component, haptoglobin and pseudocholinesterase types. *Acta Anthropogenet.*, **5**: 175-180 (1981).
- Karve, I. and Malhotra, K.C.: A biological comparison of eight endogamous groups of the same rank. *Curr. Anthropol.*, **9**: 109-124 (1968).
- Kumar, N.: ABO blood groups and sickle cell trait investigations in Madhya Pradesh, Ratlam and adjacent districts (Central India). *Bull. Anthropol. Surv. India*, **14**: 40-44 (1965).
- Kumar, N.: ABO blood groups and sickle cell trait distributions in Malwa, Western Madhya Pradesh. *J. Ind. Anthropol. Soc.*, **1**: 129-139 (1966).
- Kumar, N. and Ghosh, A.K.: ABO blood groups and sickle cell trait in Madhya Pradesh, Ujjain and Deusa district. *Acta Genet. Stat. Med.*, **17**: 55-61 (1967).
- Lakshmi, N.: *Microevolutionary Genetic Differentiation in Three Endogamous Populations of Andhra Pradesh, India*. Ph.D. Thesis, Andhra University (1994).
- Lehman, H. and Cutbush, M.: Sub-division of some Southern Indian communities according to the incidence of sickle cell traits and blood group. *Trans. Roy. Soc. Trop. Med. Hyg.*, **46**: 380-383 (1952).
- Majumder, P.P. and Ray, J.: Distribution of ABO blood groups on the Indian sub continent: A cluster - analytic approach. *Curr. Anthropol.*, **23**: 539-566 (1982).
- Malhotra, K.C.: Microevolutionary dynamics among the Gavadas of Goa. In: *Evolutionary models and studies in Human Diversity*. R.J. Meir et al (Eds.). Paris, Mouton Publishers, pp. 279-314 (1978).
- Mourant, A.E., Kopec, A.C. and Sobczak, K.D.: *Blood Groups and Diseases*. Oxford, Oxford University Press (1978).
- Rajanikumari, J. and Rao, T.V.: ABO polymorphism in eight endogamous populations of Visakhapatnam (A.P.). *Ind. J. Phys. Anthropol. Hum. Genet.*, **12**: 213-217 (1986).
- Rastogi, S. and Tyagi, D.: Rastogis and secretor status. *Man*.

- 10: 218-220 (1975).
- Reddy, V. Rami, Gunasundaramma, K., Naidu, G.P., Reddy, B.K.C., and Reddy, K.R.S.: ABO and Rh(D) blood groups in ten populations of Sri Venkateswara University area, South India. *Ind. J. Hered.*, 12: 71-79 (1980).
- Reddy, T.P.K. and Reddy, P.C.: A1A2BO and colourblindness study among Edigas and Sheiks of Chittoor district. *Indian Anthropologist*, 20: 67-71 (1990).
- Sehgal, I.K., Chahal, S.M.S. and Bhansal, L.J.S.: Genetic variation in five endogamous groups of Patiala district, Punjab. *J. Ind. Anthropol. Soc.*, 21: 63-72 (1986).
- Sherring, M.A.: *Hindu Tribes and castes - The Brahminical Tribes of the Madras Presidency*. Vol. II. Delhi, Cosmo publications pp. 105-107 (1881).
- Shivaraman, E.K., Saran, R.K. and Bhatia, H.M.: The distribution of ABO and Rh(D) blood groups in north Indian populations. *Hum. Hered.*, 21: 326-333 (1971).
- Undevia, J.V., Balakrishnan, V., Kirk, R.L., Blake, N.M., Saha, N. and Mcdermid, E.M.: A population genetic study of the Vania Soni in Western India. *Hum. Hered.*, 28: 104-121 (1978).
- Veeraraju, P., Lakshmi, N. and Rao T.V.: Blood group in Vysyas. In: *23rd Annual Conference of Indian Society of Human Genetics*. AIIMS, New Delhi (1997).
- Vyas, G.N., Bhatia, H.M., Banker, D.D. and Purandare, N.M.: Study of blood groups and other genetical characters in six Gujarati endogamous groups in Western India. *Ann. Hum. Genet.*, 22: 185-189 (1958).
- Yamamoto, F., Clausen, H., White T., Marken, J. and Hakomori, S.: Molecular genetic basis of the histo-blood group ABO system. *Nature*, 35: 229-233 (1990).