

Sickle Cell Hemoglobin and Glucose-6-Phosphate Dehydrogenase Deficiency in Two Endogamous Populations of North Coastal Andhra Pradesh, South India

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ABSTRACT Sickle cell haemoglobin and glucose-6-phosphate dehydrogenase deficiency have been studied in two endogamous populations (Paidi and Valmiki) of North Coastal Andhra Pradesh. The frequency of the sickle cell gene is very high among these two populations. The incidence of G6PD deficiency is approach the values from other populations. The results were also compared with those available from other Andhra Pradesh populations.

INTRODUCTION

Haemoglobin is an important genetic marker in molecular and population genetic studies. More than 400 structural variants of human haemoglobins have been described. Most of these structural variants result from a single base change in one or other of the globin genes that leads to the production of an abnormal haemoglobin with a single amino acid substitution. There are 60 million carriers and 1,20,000 sickle cell homozygotes are added every year in the world.

The clinical presentation of sickle cell anemia (HB SS) is extremely variable between and within different population groups (Serjeant, 1992). The environmental factors may have a minor contributory role, there are some genetic factors like higher HB F expression (Bertles, 1974; Cooper and Goagland, 1972; Dover et al., 1981, Ponnazhagan and Rita Sircar, 1992 and Kadam et al., 1996) and coinheritance of thalassemia which help to reduce the polymerization of HB S and there by ameliorate the severity of the disease (Singer and Singer, 1953; Deceular et al., 1983)

In India, the β^S gene is present mainly in the tribal and in some Scheduled Caste population groups of Central, Southern and Western region (Brittenham et al., 1979; Mukherjee and Das,

1990; Bhasin et al., 1994) and the frequency of heterozygotes ranges from 0-40% (Balgir and Sharma, 1988).

Deficiency of G6PD, a ubiquitous X-linked enzyme, is the most common disease producing enzyme defect of humans, estimated to affect 400 million people worldwide. Over 300 variants described. G6PD deficiency also appears to be the genetically heterogeneous disorder yet recognized (Luzzato and Mehta, 1989). The enzyme deficiency has wide variation in its frequency in different parts of the world. But its maximum incidence has been reported from tropical and sub tropical regions. The high gene frequency of G6PD variants in some populations appears to reflect the fact that G6PD deficiency, like sickle cell haemoglobin and thalassemia confers some protection against malaria.

A recent study describes the incidence of sickle cell haemoglobin and glucose-6-phosphate dehydrogenase deficiency in two population groups, one tribal (Valmiki) and another non-tribal (Paidi) from Visakhapatnam and Vizianagaram districts of North Coastal Andhra Pradesh, South India.

Valmikies are agriculturists and forest labourers. They practise podu cultivation on the slopes of hills. They are living in the agency areas. Paidies (Scheduled Caste), who are weavers by profession but some of their members working as bonded labourers. They are known by several other names *i.e.*, Pamidi, Dombo and Pao. However, presently many of them working a variety of government jobs from both the groups.

MATERIAL AND METHODS

A total of 700 blood specimens were collected in sterile test tubes containing ACD

solution as an anticoagulant from two endogamous populations (Paidi : 300; Valmiki: 400) belonging to both sexes from different settlements of Vizianagaram and Visakhapatnam districts of Andhra Pradesh. The plasma was separated, haemolysates were prepared and stored at -20°C until use. The lysates were screened for sickle cell haemoglobin on cellulose acetate membranes described by Kate et al. (1976). G6PD deficiency were examined on agarose gels described by Bhattacharya et al. (1990). The statistical analysis of the phenotype frequencies comprises direct gene counting method of allele frequencies and a χ^2 - test on Hardy-Weinberg equilibrium.

RESULTS AND DISCUSSION

Sickle Cell Haemoglobin

The distribution of observed and expected phenotypes and allele frequencies of sickle cell haemoglobin and the results of the χ^2 - test on the Hardy-Weinberg equilibrium are presented in table 1.

Table 1: Phenotype and gene frequencies of sickle cell in Paidies and Valmikies

Phenotype	Paidi		Valmiki	
	Observed	Expected	Observed	Expected
HB				
A	219	219.31	252	259.21
AS	75	74.38	138	125.58
S	6	6.31	10	15.21
Total	300	300.00	400	400.00
Allele				
HB*A	0.8550		0.8050	
HB*S	0.1450		0.1950	
χ^2	0.0208		3.2134	
	(0.90>p>0.80)		(0.10>p>0.05)	

The phenotype HB AS records the highest incidence among these two populations namely, Paidi (25%) and Valmiki (34.5%). While homozygous HB S exhibits in both the groups. The highest incidence observed among Valmikies (2.5%) than in Paidies (2%).

Considering gene frequencies, the HB*S allele has higher frequencies among Valmiki (0.1950) and Paidi (0.1450) population. The hamogeneity test for HB system is statistically

not significant in both the groups. However, the inter group test between two population shows statistically significant value ($\chi^2 = 7.8228$; d.f. = 2; $0.05 > P > 0.02$).

Among caste populations of Andhra Pradesh, the phenotype HB AS records a range of 0.47% (Munnuru Kapu; Lakshmi, 1986) to 25% (Paidi; present study). Thus the HB*S allele in general is absent or present in low frequencies in caste populations of this state except among Relli groups where relatively higher incidence were reported earlier (Murthy, 1971; Naidu and Mathew, 1978; Ramesh and Veerraju, 1997). Interestingly the present study population, Paidies show higher incidence of HB*S allele, when compared with other caste populations of this region.

Considering tribes of Andhra Pradesh, the frequency of the sickle cell trait ranges from 0.50% in Chenchu (Ramesh et al., 1980) to about 43.71% in Pardhans (Rao and Goud, 1979), while some of the tribes exhibit total absence of this trait, such as Raj Gond (Blake et al., 1981), Yanadi (Reddy et al., 1982) and Nail Pod (Muralidhar et al., 1989) living in the plains.

The tribes, particularly inhabiting the North-West and Eastern parts of Andhra Pradesh showed high frequency of sickle cell trait, where as the caste populations of the same region reported its complete absence. Considering Indian populations the HB*S allele is mostly present in tribes and Scheduled Castes and rare in caste groups. The present study provides further support for such a contention.

Glucose-6-Phosphate Dehydrogenase Deficiency

The distribution of G6PD deficiency in two endogamous populations are shown in table 2.

The enzyme G6PD deficiency was observed only in males of two endogamous populations. While among females no cases of deficiency were observed. The highest frequency records among Valmikies (7.50%) than in Paidies (5.33%).

The G6PD enzyme deficiency among caste populations of Andhra Pradesh, the highest incidence (7.82%) has been observed in Dhobis (Ramesh et al., 1993). While Gowda (Lakshmi, 1986) registered the lowest value (0.60%).

Table 2: Phenotype and gene frequencies of G6PD in Paidies and Valmikiies

Phenotype	Paidi		Valmiki	
	No.	%	No.	%
<i>Males</i>				
G6PD B+	142	94.67	185	92.50
G6PD B-	8	5.33	15	7.50
<i>Females</i>				
G6PD B+	150	100.00	200	100.00
G6PD B-	0	0.00	0	0.00
<i>Allele</i>				
G6PD*B+ Males	0.9467		0.9250	
G6PD*B- Males	0.0533		0.0750	
G6PD*B+ Females	1.0000		1.0000	

Where as among tribes it is found to be ranging from 1.16% in Naikpod (Rao and Goud, 1979) to 13.13% in Gutta Koya of Andhra Pradesh (Goud, 1977; Jagan Mohan Rao, 1987).

The frequency of deficient gene in different regions of India present a very heterogeneous nature. Comparatively high frequencies reported from North and West indicate that the gene has gained considerable stability in these regions, whereas in South it is uniformly low, except in a few castes and tribes of Andhra Pradesh. The occurrence of deficient allele mostly in the tribals, who reside in areas endemic to malaria, gains support to the observations that the possibility of malaria exerting selective pressure to maintain the deficient allele appears to be sound.

Further it may be worth while to mention here that none of the individuals among these two populations are found to exhibit both sickle cell trait and G6PD deficiency. It is therefore presumed that selection probably operates in the parallel lines in these groups if at all against malaria.

Some Indian populations inhabiting higher malarial endemic areas, exhibited high frequencies of G6PD*B- and Hb*S alleles with striking parallelism and this correlation holds good for most of the tribes but not for the caste groups. However, these alleles are present together or separately in higher frequencies in malarial endemic areas (Rao and Goud, 1979).

From the above discussion the present study is that the distribution of two genetic systems (sickle cell haemoglobin and G6PD deficiency) in two endogamous populations of North coastal Andhra Pradesh is more or less similar to the

rest of the populations of Andhra Pradesh, south India. Several studies have been made so far on various tribes and caste populations from different parts of Andhra Pradesh. Still, certain populations of the different regions of the state remain untouched. In view of this, further data on sickle cell HB and G6PD deficiency to be attempted if any on an extensive scale in future, would certainly enlighten us to assess the relative selective influences of these two systems on the genetic make up of the Indian population in general in the background of malaria.

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