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RESEARCH ARTICLE

MAGNITUDE OF SICKLE CELL DISEASE IN PARDHAN, GOND, KOLAM, MADGI, GOWARI AND BANJARA INDIVIDUALS OF YAVATMAL DISTRICT, MAHARASHTRA, INDIA

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ABSTRACT

In Yavatmal district the SCD has been investigated in past but unfortunately there is a dearth of detailed data in tribal population.
Aims: The present study would prove to be a small effort to find out the actual magnitude of the sickle cell disease in the tribal groups under study
Settings and Design: Small screening camps were held in easily approachable villages with the official permissions of the medical facilities available there.
Methods and Material: Screenings of samples for the presence of the sickle gene was done by solubility test and confirmation was done by Capillary Electrophoresis.
Statistical analysis used: Allele frequency was calculated by using Hardy Weinberg Principle. A dendrogram was drawn as per UPGMA clustering method using Phylip (v 3.69) and MEGA (5.2)
Results: The population studied showed 12% prevalence of HbS gene with a higher frequency among the Dravidian language family than the Indo-European language family. Screening results showed more numbers of AS individuals than the SS individuals. The prevalence was found to be more in age group (11-20Yrs) compared to other age groups. The number of affected females was much more than the males. Consanguineous marriages among the parents of affected individuals were found to be important factor to the increased number of SCD individuals.
Conclusions: The higher number of AS individuals than SS shows that the disease is spreading at an alarming rate with the major problem of more number of carriers. Dravidians being predominant among the population of Yavtmal, showing higher frequency than the Indo-European group.

INTRODUCTION

Every year about 3, 00,000 infants are born with major hemoglobinopathies, which implies about 250 million people, i.e. 4.5% of the world population are carriers (**Angastiniotis *et al.*, 1995**). Sickle cell anaemia is the second most common haemoglobinopathy, next to thalassemia in India. Central Maharashtra is reported to be in the sickle cell belt (**Kar, 1991**). This disease is particularly common among people whose ancestors come from sub-Saharan Africa; Spanish-speaking regions (South America, Cuba, Central America); Saudi Arabia; India; and Mediterranean countries such as Turkey, Greece, and Italy (**Savitt and Goldberg, 1989; Lehmann *et al.*, 1963; Sharma, 1983**). In India, the first case of sickle hemoglobin was reported in 1952 among tea garden labourers of Upper Assam (**Dunlop and Mazumder, 1952**) and simultaniously the presence of sickle cell trait was found among the aboriginal (Pre-Dravidian) Tribe (Todo) of the Nilgiri Hills in Southern India (**Lehmann and Cutbush, 1952**). Subsequent studies conducted by various workers confirmed high distribution of HbS gene in Central, Southern and North Eastern India (**Sukumaran *et al.*, 1956; Rao *et al.*,1986; Kar *et al.*, 1998; Kate *et al.*, 2002; Shukla *et al.*, 2007; Patra *et al.*, 2011; Urade, 2012; Deore and Zade, 2013**). The highest prevalence has been recorded in the state of Orissa (1-44.4%), followed by Madhya Pradesh (1-40%) including Chattisgarh, Tamil Nadu (1-40.0%), Andhra Pradesh (1-35.7%), Assam (1-35.5%), Maharashtra (0.8-35%), Gujarat (1-31.4%), Kerala (1-30%), Uttar Pradesh (1.5-18.5%), Karnataka (1-8.0%), Rajasthan (1-5.7%), West Bengal (1-1.7%) and Bihar (0.8%) including Jharkand. Available data indicates that SCD gene is widely spread in all district of Eastern Maharashtra (Vidarbha region), Northern Maharashtra (Satpuda range) and some parts of Marathwada region (**Sharma 1983; Shukla and Solanki, 1958; Zade *et al.*, 2011**).

In Rural Wardha prevalence of Sickle Cell Disorders was studied and it was found that the higher prevalence occurred among the Pardhan, Gond and Gowari (Dravidian tribes

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(**Deshmukh *et al.*, 2006**). A study conducted among tribes of India gave the instinct of the magnitude of prevalence of SCD among various tribal individuals of many states of India and reported the prevalence in Pardhan, Kolam, Gond, Gowari and other tribes residing in different states (**Uma *et al.*, 2011**). As no such previous studies indicated the real depth of the SCD prevalence in the study area, the present study is a small effort to find out the prevalence of Sickle cell disease in the selected tribal castes of Yavatmal District, 9.26° to 20.4 2°N, 77.18° to 79.98° that lies in South East region of Maharashtra state. Pradhan, Gond, Kolam, Gowari and Banjara tribal castes were selected for the study as they form the major part of the tribal population of the this area.

MATERIALS AND METHODS

Random screening of SCD was conducted in few selected tribal villages from Yavatmal District. A total of 1400 blood samples from individuals belonging to 6 different tribal castes were collected either by door to door screening or organizing screening camps in co-ordination with the officials from Primary Health Centers as well as Sub-district and Rural Hospitals, with prior written consent. For performing preliminary diagnosis (the solubility test) (**Bernard and Webber, 1979**) of SCD few drops of blood was collected by bold finger prick. Sebia Capillarys Electrophoresis was used for detecting and confirming the SCD status of all the individuals (**Cotton *et al.*, 1999; Craver *et al.*, 1996; Higgins *et al.*, 2009**).

Statistical analysis used

Allele frequency was calculated by using Hardy Weinberg Principle. A dendrogram was drawn as per UPGMA clustering method using Phylip (v 3.69) (**Felsenstein, 1993**) and MEGA (5.2) (**Tamura *et al.*, 2011**).

RESULTS

A total of 1400 individuals belonging to six tribal castes were screened from selected villages of Yavatmal District. The population was predominated by Pardhans followed by Gond, Kolam Gowari, Banjara and Madgi. The Sickle Cell gene prevalence was seen highest among Pardhans which was followed by Gond, Kolam and Madgi. However, SCD was less prevalent among Gowari and Banjara (Table 1). Capillary Electrophoresis of the blood samples, distinguished them in two groups as SCD Homozygous (SS) and SCD Heterozygous (AS). In both the groups the prevalence was more among Pardhan followed by Gond, Kolam and Madgi. However, in Gowari and Banjara no homozygous (SS) individuals were observed but the number of heterozygous (AS) individuals were quite high (Table 2). When the SS and AS individuals were distributed in different age groups, it was seen that the youngest age group (1-10 Yrs) had quite lower prevalence than the next higher age group (11-20 Yrs). However, the prevalence increased with the older age groups. But the 41-50 Yrs and 51-60 Yrs age groups had very low frequency of SCD. In each age group the prevalence of AS individual was more than the SS individuals (Table 3). The SS and AS individuals were differentiated among the males and females in different age groups. For both males and females Highest frequency of SCD was recorded in 11-20 Yrs age group followed by 21-30 Yrs and 31-40 Yrs. 1-10 Yrs age group showed somewhat lower frequency of SCD than the older age groups. However, 41-50 Yrs and 51-60 Yrs age groups showed lowest frequency of SCD than the younger age groups. In each age group the females were showing more prevalence of SCD than the males (Table 4).

In all the three age groups (1-10 Yrs, 11-20 Yrs and 21-30 Yrs) more number of consanguineous marriages among the parents of affected individuals under study were observed. However, the older age groups 31-40 Yrs, 41-50 Yrs and 51-60 Yrs showed lower number of consanguineous marriages among the parents of affected individuals (Table 5). Allele frequency of HbS gene was found to be highest in Pardhan followed by Gond, Kolam and Madgi. However, Gowari and Banjara had lower values of it (Table 6). Dendrogram showed Gond as the most ancestral group among all, from which Pardhan separated first followed by Kolam and Madgi. However Gowari and Banjara being evolved groups were placed at the outer edges forming the outgroup (Fig. 1).

DISCUSSION

Screening results of six tribal groups showed quite high prevalance of SCD. Being predominant population, Pardhans had highest SCD prevalence followed by the next major population group i.e. Gond. A similar study conducted in central India showed that the Pardhans of Yavatmal (16.8-33.7%) and the Gond of Vidarbha showed quite high value (15.65%) (**Urade, 2012**). Among Gonds of Madhya Pradesh, the prevalence of sickle haemoglobin varies from 10% to 25% (**ICMR, 1986**). Whereas, Kolam and Madgi had quite lower values of SCD prevalence. So also, Gowari and Banjara showed very less SCD percentage. A similar study, Kolam of Yavatmal were reported to have nearly similar percentage of SCD (8.33%) (**Urade, 2012**). However, Banjara had similar prevalence in Vidarbha (5.88%) as found in the study. But the Pardhan and Kolam of Andhra-Pradesh had quite high SCD prevalence rate 33.71% and 14.88% respectively (**Goud and Rao, 1979; Undevia *et al.*, 1981**). Another study found that the the prevalence was maximum in Matang (15.8%) followed by Pardhan (10.6%) and Gowari (5.8%) (**Deshmukh *et al.*, 2006**). A recent study conducted in urban population of eastern part (Vidarbha) of Maharashtra showed prevalance of various tribes residing there, Pardhan (11.49%), Gond (14.28%), Kolam (6.89%) and Gowari (5.88%) and Banjara (7.07%) (**Deshmukh *et al.*, 2006**). In this investigation the frequency of HbS gene was observed in between 05 and 16% which was in accordance with the frequency (0-20%) reported in a study of Central India[27] although, it is quite lower than those reported in earlier studies (**Shukla and Solanki, 1958; Deshmukh and Sharma, 1968; Negi, 1976; Balgir, 2008**).

Capillary Electrophoresis results distiguisshed the individuals into SS, AS and AA individuals. In each caste group the number of AS individuals were more or nearly doubled than the SS individuals. Overall number of AS individuals 104/1400 (7.43%) was almost double than SS individuals 64/1400

Table 1. Solubility test data

Population	Phenotype	
	Solubility test-ve No. of individuals (%)	Solubility test +ve No. of individuals (%)
Pardhan n=630	532 (84.44%)	98 (15.56%)
Gond n=300	266 (88.67%)	34 (11.33%)
Kolam n=196	178 (90.82%)	18 (9.18%)
Madgi n=76	70 (92.10%)	06 (7.89%)
Gowari n=114	106 (93.22%)	08 (6.78%)
Banjara n=84	80 (95.0%)	4 (5.0%)
Total n=1400	1232 (88.0%)	168 (12.0%)

Table 2. Capillary Electrophoresis Results

Population	SCD Homozygous (SS)	SCD Heterozygous (AS)	Normal (AA)
Pardhan	42 (65.62%)	56 (53.84%)	28 (46.67%)
Gond	12 (18.75%)	22 (21.15%)	20 (33.34%)
Kolam	08 (12.5%)	10 (9.61%)	04 (6.66%)
Madgi	02 (3.12%)	04 3.84%)	02 (3.33%)
Gowari	00	08 (7.69%)	02 (3.33%)
Banjara	00	04 (3.84%)	04 (6.66%)
Total	64	104	60

Table 3. Age-wise Distribution of SCD prevalence among SS, AS and AA individuals

Age in Years	Total	No. Of SS Individuals (%)	No. Of AS Individuals (%)	No. Of AA Individuals (%)
1 to 10	132	10 (15.63%)	12 (11.53%)	110 (8.92%)
11 to 20	496	26 (40.63%)	40 (37.26%)	430 (34.90%)
21 to 30	300	12 18.75%)	28 (28.02%)	260 (21.11%)
31 to 40	276	12 (18.75%)	18 (17.30%)	246 (19.97%)
41 to 50	100	02 (3.12%)	04 (3.84%)	94 (7.63%)
51 to 60	96	02 (3.12%)	02 (1.92%)	92 (7.47%)
Total	1400	64	104	1232

Table 4. Age-wise Distribution of Sickle cell gene positive (SS and AS) male and female individuals

Age	Total (SS + AS)	Males	Females
1 to 10	22	04 7.40%	18 15.78%
11 to 20	66	20 37.04%	46 40.36%
21 to 30	40	18 33.34%	22 19.29%
31 to 40	30	08 14.82%	22 19.29%
41 to 50	06	02 3.70%	04 3.51%
51 to 60	04	02 3.70%	02 1.76%
Total	168	54	114

Table 5. Parental Consanguinity

Age	SS		AS		AA		Total (n=228)
	Males (n=24)	Females (n=40)	Males (n=30)	Females (n=74)	Males (n=24)	Females (n=36)	
1 to 10	04	06	04	04	02	00	20
11 to 20	04	02	04	06	02	02	20
21 to 30	00	04	02	08	00	04	18
31 to 40	02	02	04	02	03	02	15
41 to 50	00	00	02	04	01	00	11
51 to 60	00	04	00	02	02	00	04
Total	10	18	16	26	10	08	88

Table 6. Allele frequency

Population	Allele Frequency	
	HbA	HbS
Pardhan	0.8888889	0.111111
Gond	0.923333	0.076667
Kolam	0.933673	0.0666327
Madgi	0.947368	0.052632
Gowari	0.964912	0.035088
Banjara	0.97619	0.02381
Total	0.917143	0.082857

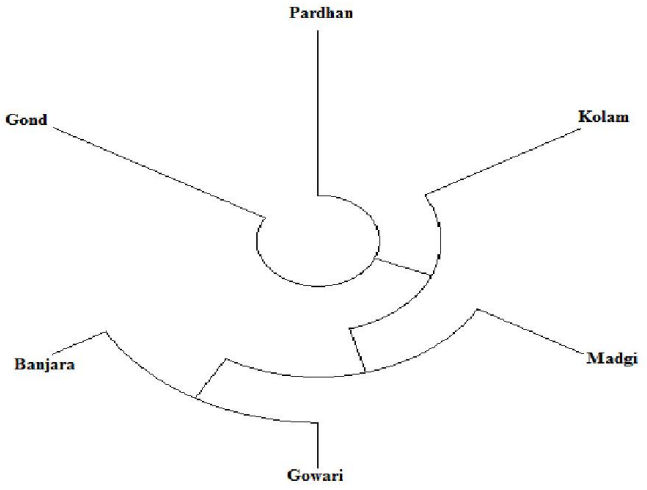

Fig. 1. Dendrogram

(4.57%). These results are supported by another study wherein they screened a total of 3479 individuals, amongst them, 172 (4.94%) individuals were found to be positive for sickle cell disorder, of which 135/172 (3.88%) with AS and 37/172(1.06%) with SS from the urban parts of east Maharashtra (Deore and Zade, 2013). In each age group, the number of AS individuals was quite higher than the SS individuals studied. This is because the number of SCD hetrozygote is increasing at alarming rate. Based on 1981 census figures of population in India, it was estimated that there were 24, 34,170 carriers and 1, 21,375 sickle cell homozygotes among the tribes of India (Leikin *et al.,* 1989). Age–wise data of SCD prevalence showed that the youngest age group (1-10 Yrs) had 15.63% of SS and 11.53% of AS individuals. However, the next age group (11-20Yrs) had more than the double persentage of SCD in both SS and AS individual. Next two age groups (21-30 Yrs and 31-40Yrs) also showed a higher frequency of SCD but it was quite less than the age group (11-20Yrs). In the study conducted in a population of eastern part (Vidarbha) of Maharashtra also showed similar persentage i.e. high prevalence between the age 0 and 30 Yrs and its severity declined with increasing age (**Deore and Zade, 2013**). The reason for the low prevalence in higher age groups may be attributed to very small sample size, secondly most of the sickle cell patients could have succumbed to the disease in early age.

The number of female individuals was found to be more or nearly double than the male individuals in all age groups. The youngest age group had quite lower frequeny than the next higher age group and then the frequency was declining as the age advanced. Similarl study conducted at Rural Wardha found that the prevalence of the disorder was 2.8% in males and 3.0% in females. As regards to sex distribution of the disorder, sickle cell trait is more common in females (**Wintrobe, 1993**).

SS males (10/24 (41.67%)) were less than the SS females (18/40 (45.0%)). Whereas, AS males (16/30 (53.34%)) were more than AS females (26/74 (35.14%)). Similarly, AA males (10/24 (41.67%)) were more than AA females (08/36 (22.23%)). Younger age group (1-10 Yrs, 11-20 Yrs and 21-30 Yrs) showed higher persentage of parental consanguinity than the members of elder age groups indicating that the number of consanguineous marrieages is increasing day by day. Children of such a marriage, therefore, are at a greater risk of being homozygous for the harmful gene and consequently suffer autosomal recessive genetic disorders (**McKusick, 1972**). The sickle cell trait is most serious problem which acts as a carrier for propagation of anemia among the society through consanguineous marriages (**Kate, 2000**).

The allele frequency was found to be highest in Pardhans, Gond was showing the next higher allele frequency followed by Kolam and Madgi. The allele frequency of Pardhan and Kolam of Andhra-Pradesh was found to be 0.159 and 0.077 (**Goud and Rao, 1979; Undevia *et al.*, 1981**). Pardhan of other regions of Maharashtra were showing similar value (0.168) (**Bankar, 1984**).And the Gond of Madhya-Pradesh was showing near about the similar value (0.090) (ICMR, 1986) as that of the individuals under study. All these tribes belong to Dravidian Language family. The HbS allele frequency of Dravidian Family of Indian tribes was reported to be 0.000-0.410 (**Bhasin, 2006**). However in the present work, Gowari and Banjara belonging to Indo-European language family show quite lower HbS frequencies. The HbS allele frequency of Indo-European Family of Indian tribes was reported to be 0.000-0.200 (**Bhasin, 2006**). However, Dravidians being predominant among the population of Yavatmal, show higher HbS frequency than the Indo-European group. This is in corroboration to the multicentric study conducted among the primitive tribes of India showing a very high HbS allele frequency observed among the Dravidian (0.060-0.120) and Indo-European (0.060-0.076) as compared to Austro-Asiatic (0.011-0.022) speaking tribal group (**Mohanty, 2013**).

Dendrogram showed that Gond being the primitive group forms the root whereas, Pardhan being next advanced group separated first. Then Kolam and Madgi separated afterwards. Gowari and Banjara being most evolved among all, both were forming an outgroup. There are a number of similarities between African and Indian sickle cell anemia especially in relation to the sickle cell common among Fulani people living throughout Africa (**Aravanan, 1980**). Linguist have reported that the Fulani and Dravidian languages are genetically related (**Winters, a 2007; b 2008**). The reality that sickle cell is found mainly among the Indian tribal groups which have rarely interacted with outsiders makes it clear that it was probably carried to India when Dravidians migrated from Nubia to South India (**Winters, 2008**). The arrival of the Indo-European speakers via the Northern corridor of India around 3,500–4,000 years ago is believed to be responsible for one of the major influxes of people in the Indian subcontinent (**Cavalli-Sforza, 1994**). The Present study supports to this, showing that Indo-European speaking tribal group might be the latter immigrant of the Indian Subcontinent with more number of mutations in the β globin gene.

Conclusion

Tribal population of Yavatmal had 12% prevalence of HbS gene, showing quite high frequency. The overall frequency of AS individual (7.43%) was nearly double than the SS

individuals (4.57%). The age group 11 to 20Yrs had the highest frequency in both (SS and AS) individual and it was seen declining as the age advances. The male to female ratio show more numbers of affected female members than that of male members. The predominant Dravidian family members were found to have the higher frequency than that of the Indo-European family members showing that the disease is more prevalent in primitive tribes than that of the evolved groups. Coming to the square one, the Sickle Cell Disease has been widely spread in the tribal population of Yavatmal, which needs to be deeply investigated with proper implementation of control programmes.

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