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Clinical and Hematological Profile of Hemoglobinopathies in Two Tribal Communities of Sundargarh District in Orissa, India

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KEY WORDS Sickle cell disease, hemoglobin E trait, Beta-thalassemia trait; clinical picture; hematological profile; tribal communities; Orissa state; India

ABSTRACT Tribal communities constitute a major chunk of population in India. They are vulnerable to many hereditary disorders of erythrocytes. Hemoglobinopathy is one of them. The present study has been carried out in Bhuyan and Kharia tribes of Sundargarh district in Orissa state. Following the probability proportionate to size (PPS) cluster sampling procedure, a total of 1002 blood samples of tribal subjects (244 Bhuyan and 758 Kharia) were screened for different hemoglobinopathies. Laboratory analyses were carried out taking the complete hemogram, performing NESTROFT and sickling test, hemoglobin electrophoresis, estimation of fetal hemoglobin and of A_2 fraction of adult hemoglobin following the standard procedures. Study showed the high prevalence of hemoglobinopathies (13.1%) in both Bhuyan and Kharia tribe. For the first time, hemoglobin E has been detected in a tribal population, i.e. Delki Kharia in the state of Orissa. Except beta-thalassemia trait, no other hemoglobinopathy was detected in Dudh Kharia tribe showing their genetic isolation from Delki Kharia. The over-all prevalence of different grades of anemia is much higher in Bhuyan tribe (89.9%) than in Kharia tribe (73.8%). The clinical and hematological picture of sickle cell disorders in the present study is consistent with the previous studies from Orissa. It is interesting that as we move from lower age categories to higher age categories, the number of cases of hemoglobinopathy goes on decreasing in both Kharia and Bhuyan tribes under natural environmental conditions showing probably age specific mortality. These findings have been discussed in the light of previous studies available from the state of Orissa.

INTRODUCTION

India is ethnically a heterogeneous country. There are several ethnic groups, castes, scheduled castes and tribes who flourish altogether in India. There are 62 scheduled tribes in the state of Orissa. They constituted 22.21% of the total population in the state of Orissa in 1991 census. The tribes of Orissa form 10.84% of the total tribal population of India. In the state of Orissa, tribes are vulnerable to many hereditary disorders including hemoglobinopathy and thalassemia. These genetic disorders cause high degree of hereditary hemolytic anemia, jaundice, joint pains, painful crisis, hepatosplenomegaly, growth retardation, etc. and affect the general health of an individual. Concerted efforts are required to improve the quality of life of these affected persons of hemoglobinopathy in India (Balgir 1999).

The clinical and hematological features of different variants of hemoglobin are extremely variable. Although no definite cure is available for sickle cell disease, the clinical manifestations make this disease burdensome, but can be managed and prevented (Balgir 1999, 2000, 2002a). There is a paucity of data on the clinical and hematological status of sickle cell disorders in India. Therefore, a comparison of clinical and hematological features of different hemoglobin variants may yield important information on the steady state under natural environmental conditions.

The aims of this study were to investigate the prevalence of hemoglobinopathy, and to determine the clinical and hematological profile of different variants of hemoglobin among tribal communities from the state of Orissa. The data so generated would help development of management, prevention and control programme for hemoglobinopathy in India.

MATERIALS AND METHODS

The study was carried out in Sundargarh district of Orissa. This district is bordering

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district, surrounded by Jharkhand state in the North, Chhattisgarh state in the West, Keonjhar district in the East and Jharsuguda, Sambalpur, and Deogarh districts in the Southern part of the district (Fig.I). As per 1991 census, the total population of Sundargarh district was 15,73,617, which constituted 50.7% tribal population of the district. Out of the total 40 scheduled tribes, there are five major tribes in the district, namely Bhuyan, Kharia, Kissan, Munda and Oraon, having more than one lakh population of each tribe as per 1981 census. The scatter and distribution of these tribes in particular locality is shown in the Adavasi Atlas of Orissa (Sinha 1987).

Both Bhuyan and Kharia tribes are traditionally industrious agriculturists and follow tribe endogamy. Kharia tribe has two distinct subgroups, Dudh (pure) Kharia and Delki Kharia, based on the religion and socio-cultural practices, although originally they belonged to one stock. Dudh Kharias are now converted Christians, where as, Delki Kharias are Hinduised tribe. The marriage between these two sects is now unheard. Bhuyan tribe is also having two subgroups, i.e. Paik or Khandyat (warrior) Bhuyan and Paraja (public) Bhuyan. Following the probability proportionate to size cluster sampling procedure, the present study was carried out in four blocks, namely, Balisankara, Bargaon and Subdega for Kharia tribe and Hemgiri block for Bhuyan tribe. A total of 758 Kharia (368 males and 390 females) and 244 Bhuyan (113 males and 131 females) tribals belonging to all age groups were screened for hemoglobinopathies from Sundargarh district of Orissa during the period from July 2000 to September 2002.

About 2-3 ml. intravenous blood was collected using ethylene diamine tetra acetic acid (EDTA) as anticoagulant by disposable syringes and needles from each individual after obtaining the informed consent in the presence of a doctor and community leaders. All the signs and symptoms related to hemoglobinopathy were recorded by the doctor after clinical examination on the pre-designed proforma. Any other ailment present was treated/referred to local health facility.

Blood samples so collected were transported to laboratory at Bhubaneswar under ice-cold

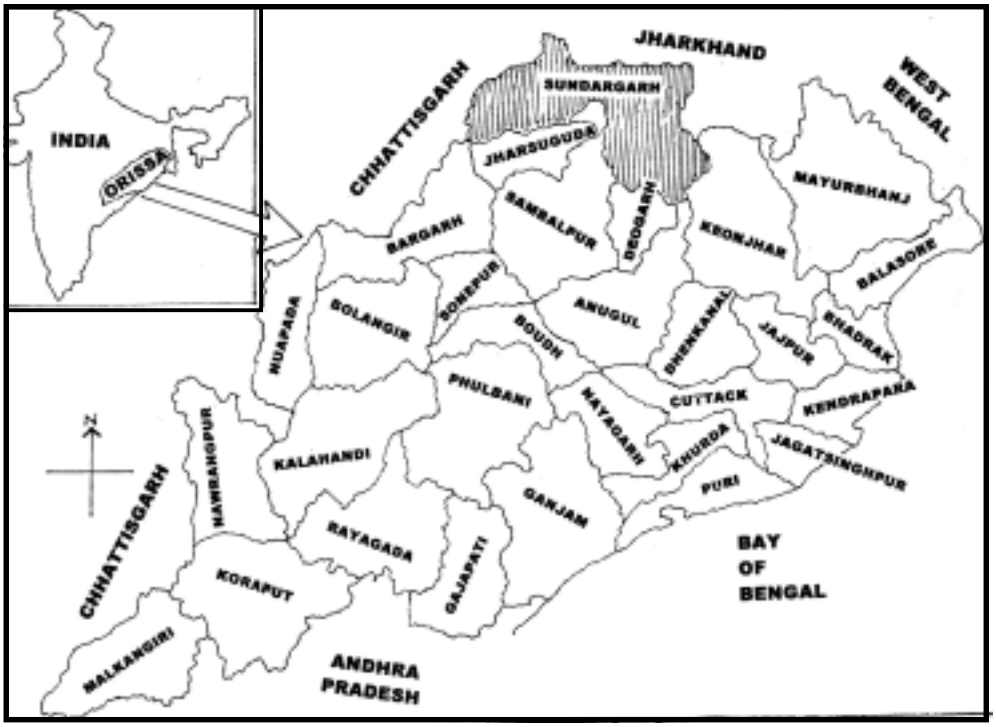

Fig. 1. Map of Orissa showing study area.

conditions within 24 hours of collection. Laboratory investigations were carried out following the standard procedures after cross checking from time to time for quality control. Hematological parameters of some cases were studied by using an automated particle cell counter (Model- MS4, Melet Schloesing Laboratories, France), when it was available. Grading of anemia was done as per the WHO guidelines (WHO Report 1989).

The sickling test was performed by using freshly prepared sodium metabisulphite solution as reducing agent (Daland and Castle, 1948). The routine hemoglobin electrophoresis was carried out on cellulose acetate membrane (CAM) in Tris-EDTA-Borate buffer at pH 8.6 and quantification of A_2 fraction of hemoglobin by elution method at pH 8.9 (Weatherall 1983; Dacie and Lewis 1991). The value more than 3.5% of A_2 fraction of hemoglobin was taken as cut off point for determining the beta-thalassemia trait. Estimation of fetal hemoglobin was done by alkaline denaturation by Singer et al. (1951) and Betke et al. (1959) method as described by Weatherall (1983). Family studies were carried out to confirm the diagnosis, wherever it was necessary.

RESULTS

Different hemoglobinopathies detected during the study are shown in Table1. Sickle cell trait and beta-thalassemia trait are the most frequently encountered hemoglobinopathies in both Bhuyan (5.3% and 6.6%) and Kharia (5.3% and 6.2%) tribes, respectively in Sundargarh district of Orissa. However, three cases of sickle cell-beta-thalassemia were encountered in the present study. Cases of both homozygous sickle cell disease and hemoglobin E disease have been detected in Delki Kharia. High levels of fetal hemoglobin were recorded in sickle cell disorders (range: 5.3-12.7%). For the first time, hemoglobin E has been detected in a tribal population, i.e. Delki Kharia in the state of Orissa. However, the cases of hemoglobin E have been detected in other caste populations in the coastal region of Orissa. It is interesting to note that except beta-thalassemia trait, no other hemoglobinopathy was detected in Dudh Kharia tribe which is indicative of their still keeping purity of the blood by not mixing with any other tribal or nontribal population.

This study shows the over-all prevalence of 13.1% of hemoglobinopathies among both Bhuyan and Kharia tribes in Sundargarh district of Orissa.

Visible clinical symptoms of hemoglobinopathy cases were also recorded. Most common features observed among hemoglobinopathy cases in steady state were: pallor, fatigue, joint pains, recurrent fever, abdominal pains, chest pains, etc. (Table 2).

Both Bhuyan and Kharia tribal communities were evaluated for different grades of anemia based on levels of hemoglobin as per WHO classification. It has been observed that mild to moderate anemia is more pronounced in children and adult female groups than in the adult male group in Kharia tribe, whereas, in Bhuyan tribe both the adult males and adult females showed the high frequency of mild to moderate anemia (Table 3). The over-all prevalence of different grades of anemia is much higher in Bhuyan tribe (89.9%) than in Kharia tribe (73.8%). The incidence of severe anemia was low (0.6-1.5%) in both tribal communities of Sundargarh district of Orissa.

Different grades of anemia in controls and in cases of different hemoglobinopathies prevalent in Sundargarh district of Orissa are presented in Table 4.

Complete hemogram of some cases were taken to evaluate the hematological profile (Table 5). It is apparent from the table that the cases of

Table 1: Status of hemoglobinopathies among Bhuyan and Kharia Tribes of Sundargarh District in Orissa

Hemoglobinopathies	*Delki Kharia (N=337)*		*Dudh Kharia (N=421)*		*Total Kharia (N=758)*		*Bhuyan (N=244)*	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Sickle Cell Trait	40	11.9	0	0.0	40	5.3	13	5.3
Sickle Cell Disease	2	0.6	0	0.0	2	0.3	0	0.0
Sickle cell-beta-Thalassemia	0	0.0	0	0.0	0	0.0	3	1.2
Hemoglobin E Trait	9	2.7	0	0.0	9	1.2	0	0.0
Hemoglobin E Disease	1	0.3	0	0.0	1	0.1	0	0.0
Beta-Thalassemia Trait	15	4.5	32	7.7	47	6.2	16	6.6

Table 2: Clinical profile of hemoglobinopathy cases in two tribes from Sundargarh District of Orissa

	Kharia					*Bhuyan*		
	Beta-Thal. Trait	*SCT*	*SCD*	*HbAE*	*HbEE*	*Beta-Thal Trait*	*SCT*	*SC-β-Thal*
Symptoms	*(n=47)*	*(n=40)*	*(n=2)*	*(n=9)*	*(n=1)*	*(n=16)*	*(n=13)*	*(n=3)*
Fatigue	5	7	-	3	-	4	6	-
Dysponea	-	4	-	-	-	-	1	-
Recurrent Fever	1	6	-	-	-	3	-	-
Pallor	11	5	1	1	1	2	3	1
Jaundice	-	1	-	-	-	-	-	-
Abdominal Pains	1	3	-	-	-	-	-	-
Joint Pains	3	7	1	1	-	1	-	1
Hepatomegaly	1	-	-	1	-	-	-	
Splenomegaly	-	-	-	1	-	1	-	1
Chest Pains	1	5	-	-	-	-	1	-
Epistaxis	1	1	-	-	-	-	-	-
Cardiac Murmer	1	-	-	-	-	1	-	-
Edema	-	-	-	-	-	-	1	-

SCT= Sickle Cell Trait, SCD= Sickle Cell Disease, SC-β-Thal = Sickle Cell-beta-thalassemia, HbAE= Hemoglobin E Trait, HbEE= Hemoglobin E Disease, Beta-Thal.Trait=Beta-Thalassemia Trait

Table 3: Different grades of anemia in Bhuyan and Kharia Tribes of Sundargarh District in Orissa

Tribes	*Severe*		*Moderate*		*Mild*		*Normal*	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Kharia (N=638):								
Children	1	0.2	56	8.8	123	19.3	42	6.6
Male Adults	1	0.2	17	2.7	107	16.8	71	11.1
Female Adults	2	0.3	48	7.5	116	18.2	54	8.5
Total	4	0.6	121	19.0	346	54.2	167	26.2
Bhuyan (N=198):								
Children	1	0.5	12	6.1	23	11.6	2	1.0
Male Adults	0	0.0	16	8.1	52	26.3	15	7.6
Female Adults	2	1.0	40	20.2	32	16.2	3	1.5
Total	3	1.5	68	34.3	107	54.0	20	10.1

Children } <7.0 g/dl= Severe; 7.1-10.0 g/dl= Moderate
Female Adult } 10.1-12.0 g/dl= Mild; >12.1g/dl= Normal
Male Adult } <7.0 g/dl= Severe; 7.1-10.0 g/dl= Moderate
10.1-13.0 g/dl= Mild; >13.1 g/dl= Normal

sickle cell trait, hemoglobin E trait, and beta-thalassemia trait do not show variations in their hematological profile from that of normal (control) cases under normal circumstances. However, the values for homozygous cases are considerably below normal showing the severe hematological manifestations.

DISCUSSION

The high frequency of hemoglobinopathy (13.1%) reported in both Bhuyan and Kharia tribes from Sundargarh district of Orissa imply that hemoglobin disorders are quite common at birth among these populations. Sickle cell trait and beta-thalassemia trait are the most frequently encountered hemoglobinopathies. However, three cases of double heterozygosity have been detected in Bhuyan tribe for these abnormalities in the present study. A remarkable difference observed between Dudh Kharia and Delki Kharia tribes was that except for beta-thalassemia trait, no other hemoglobinopathy was detected in Dudh Kharia tribe. This may be an indicative of

an isolation of these two tribal sects who originally had a common stock in the distant past. Dudh Kharias are converted Christians, whereas, the Delki Kharias are Hinduised tribe. The marriage between these two sects is now prohibited. These findings show the evolutionary trend of founder effect and genetic drift in two sects of Kharia tribe of Sundargarh district in Orissa.

For the first time, hemoglobin E has been detected in trait and disease form in a tribal population, i.e. Delki Kharia in the state of Orissa. However, some cases of hemoglobin E have earlier been reported in other caste populations in the coastal region of Orissa, West Bengal and North Eastern part of India (Balgir 2002b). The presence of hemoglobin E among the Delki Kharia tribe shows the admixture with other tribes and/ or nontribal populations of West Bengal or North Eastern India among whom this trait is quite frequently observed (Balgir 1996).

Comparatively, the absence or less number of homozygous cases of sickle cell anemia among the Bhuyan and Kharia tribes in the present study indicates almost similar conditions in those tribes who are worse off economically with poor nutritional and hemoglobin level status, low earning capacity and poor access to health care facilities. This leads to increased mortality during infancy and early childhood (Kaur et al. 1997).

Different variants of hemoglobinopathy manifest variable clinical and hematological profile in India. Clinical findings of the present study are consistent with the earlier studies from Orissa (Kar et al. 1986; Kaur et al. 1997; Balgir 2002a). However, there were variations with respect to visible anemia and anemia observed as per WHO classification (1989) based on levels of hemoglobin in children (0-14 years age), adult females (>14 years age) and adult males (>14 years age). The over-all prevalence of different grades of anemia was much higher in Bhuyan tribe (89.9%) than in Kharia tribe (73.8%). This may be due to difference in prevalence of iron deficiency, parasitic infections, parasitic infestations, food habits, ethnic variations and other socio-cultural factors between the two tribes. These findings of high prevalence of anemia are consistent with

Table 4: Different grades of anemia in controls and in cases of different hemoglobinopathies in Sundargarh District of Orissa

	Severe		*Moderate*		*Mild*		*Normal*	
Group	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Controls (N=836)								
Children	2	0.2	68	8.1	146	17.5	44	5.3
Male Adults	1	0.1	33	3.9	159	19.0	86	10.3
Female Adults	4	0.5	88	10.5	148	16.7	57	6.8
Total	7	0.8	189	22.6	453	54.2	187	22.4
Sickle Cell Trait (N=48)								
Children	0	0.0	2	4.2	10	20.8	3	6.3
Male Adults	0	0.0	2	4.2	8	16.7	7	14.6
Female Adults	1	2.1	3	6.3	6	12.5	6	12.5
Total	1	2.1	7	14.6	24	50.0	16	33.3
Hemoglobin E Trait (N=9)								
Children	0	0.0	0	0.0	1	11.1	1	11.1
Male Adults	0	0.0	1	11.1	2	22.2	2	22.2
Female Adults	0	0.0	1	11.1	1	11.1	1	11.1
Total	0	0.0	2	22.2	4	44.4	3	33.3
Beta-Thalassemia Trait (N=63)								
Children	1	1.6	6	9.5	12	19.0	1	1.6
Male Adults	0	0.0	2	3.2	13	20.6	2	3.2
Female Adults	1	1.6	9	14.3	11	17.5	5	7.9
Total	2	3.2	17	27.0	36	57.1	8	12.7

Children] <7.0 g/dl= Severe; 7.1-10.0 g/dl= Moderate
Female Adult } 10.1-12.0 g/dl= Mild; >12.1 g/dl= Normal
Male Adult } <7.0 g/dl= Severe; 7.1-10.0 g/dl= Moderate
} 10.1-13.0 g/dl= Mild; >13.1 g/dl= Normal

our previous studies (Balgir et al. 1999, 2002) carried out among the tribals of Mayurbhanj (Bathudi, Bhumiz, Kolha and Santhal) and Kalahandi (Gond) districts of Orissa.

It is apparent from Table 4 that the distribution of different grades of anemia in control group and different carrier categories of abnormal hemoglobin like sickle cell trait, hemoglobin E trait and beta-thalassemia trait does not show much variation in children, adult females and adult males. This indicates that the severity of the disease is not manifested in the heterozygous condition or in other words, the heterozygotes of the disease behave more or less like normal individuals under the natural (normal) environmental conditions.

Hematological profile of different abnormal hemoglobin categories is almost similar to those of previous studies from Orissa (Kar et al. 1986; Roy et al. 1996; Kaur et al. 1997; Balgir 2002a). Kar et al. (1986) had studied hematological parameters only in those of homozygous sickle cell disease patients having mixed ethnic background, who had attended the hospital. The sample of subjects taken by Roy et al. (1996) although was from Sundargarh district of Orissa, but was also of mixed population of tribal as well as nontribal origin. Only one study (Kaur et al. 1997) had carried out the hematological investigations among the suspected cases of sickle cell disease in Kondh tribe of Phulbani district in Orissa. The results of all these studies showed consistent pattern of low level of hemoglobin, low MCH and low RBC counts in sickle cell disease patients as compared to sickle cell trait and normal controls (Table 5). These results are in agreement with the present study. Almost similar pattern emerges out with regard to hemoglobin E trait and beta-thalassemia trait as compared to controls.

Table 6 shows the distribution of hemoglobinopathy cases in different age group categories in the present study. It is interesting to note from the table that there emerges a consistent pattern that as we move from lower age categories to higher age categories, the number of cases of hemoglobinopathy goes on decreasing consistently in both Kharia and Bhuyan tribes under normal or natural environmental conditions. This probably suggests that the cases of hemoglobinopathy are unable to cope with the stressful situation in life and succumb to various types of infections and adverse circumstances, and die early at the prime age of life. These findings have further been supported by our earlier hospital based studies from Orissa, which suggested the age specific mortality in the sickle cell disease cases (Balgir 1993).

CONCLUSIONS

Inherited defects of blood like sickle cell trait and disease, hemoglobin E disease, and beta-

Table 5: Comparison of hematological parameters of hemoglobinopathy cases from Orissa

	Hb (g/dl)	*RBC (x 10^6/µl)*	*HCT (%)*	*MCV (fl)*	*MCH (pg)*	*MCHC (g/dl)*	*WBC (x 10^3/µl)*
Source	*Mean±SD*	*Mean±SD*	*Mean±SD*	*Mean±SD*	*Mean±SD*	*Mean±SD*	*Mean±SD*
Kar et al., 1986:							
Hb SS (N=130)	8.7±1.7	3.3±0.8	-	83.6±9.4	26.6±3.6	31.5±2.7	-
Roy et al., 1996:							
Hb AA (N=75)	11.5±1.8	4.5±0.6	34.8±5.9	76.5±9.7	25.6±3.8	33.2±2.6	9.8±8.0
Hb AS (N=62)	11.4±2.1	4.6±0.8	33.7±5.8	73.6±9.9	25.0+4.0	33.8+1.8	8.7±3.0
Hb SS (N=21)	8.1±1.4	3.0±0.6	27.1±16.3	78.6±9.0	27.0±3.7	33.1±5.8	13.7±5.6
Kaur et al., 1997:							
Hb AA (N=26)	12.1±2.0	4.8±0.8	40.6±6.9	86.6±10.0	23.8±1.0	29.4±1.1	6.9±2.7
Hb AS (N=43)	11.4±2.0	4.4±1.2	35.7±7.2	83.5±9.2	24.5±2.8	29.4±1.6	7.8±2.0
Hb SS (N=34)	8.6±2.1	2.7±0.8	27.5±7.4	98.3±10.5	29.3±3.3	30.0±2.0	8.1±4.2
Present Study:							
Hb AA (N=453)	11.0±1.6	5.1±0.7	39.3±5.4	77.1±7.8	21.6±2.9	28.0±2.2	6.2±2.4
Hb AS (N=35)	11.3±2.2	5.5±1.0	40.9±7.6	74.9±7.1	21.1±3.6	27.2±2.4	6.2±2.2
Hb SS (N=1)	10.2	5.8	38.1	65.8	17.7	26.9	9.0
Hb AE (N=3)	11.8±2.3	5.9±0.8	43.2±7.2	73.5±2.9	20.1±1.3	27.4±0.7	7.6±2.3
Hb EE (N=1)	9.1	5.2	34.0	65.0	17.4	26.7	6.4
Beta-Thal. Trait (N=35)	10.7±1.4	5.1±0.7	38.2±4.8	75.8±7.6	21.1±2.5	27.8±2.0	6.6±2.0

Table 6: Distribution of hemoglobinopathy cases in different age group categories

Age Groups in years	*1-10*	*11-20*	*21-30*	*31-40*	*41-50*	*51-60*	*61+*	*Total*
Delki Kharia (N=337):								
Sickle Cell Trait	9	8	9	5	5	2	2	40
Sickle Cell Disease	1	0	1	0	0	0	0	2
Hemoglobin E Trait	1	3	2	1	0	0	2	9
Hemoglobin E Disease	0	0	0	0	1	0	0	1
Beta-Thalassemia Trait	5	1	1	2	2	3	1	15
Total	16	12	13	8	8	5	5	67
Dudh Kharia (N=421):								
Beta-Thalassemia Trait	6	8	3	6	5	2	2	32
Kharia (N=758)	22	20	16	14	13	7	7	99
%	2.9	2.6	2.1	1.9	1.7	0.9	0.9	13.1
Paik Bhuyan (N=216):								
Sickle Cell Trait	1	3	2	1	3	1	1	12
Beta-Thalassemia Trait	2	2	3	1	4	2	1	15
Sickle Cell-Beta-Thalassemia	0	0	0	0	1	1	1	3
Total	3	5	5	2	8	4	3	30
Paraja Bhuyan (N=28):								
Sickle Cell Trait	0	1	0	0	0	0	0	1
Beta-thalassemia Trait	0	0	0	0	0	0	1	1
Bhuyan (N=244)	3	6	5	2	8	4	4	32
%	1.2	2.4	2.1	0.8	3.3	1.6	1.6	13.1

thalassemia are the major hematological and genetic disorders prevalent among the tribal communities of India. They are not curable and cause high degree of morbidity and mortality in India, thus, need special intervention strategies for prevention and control in India.

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