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Original Research Article

Prevalence of Hemoglobinopathies in Tribal Region of India: A Retrospective Observational Study

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ABSTRACT

Hemoglobinopathies are the common inherited diseases around the world. Thalassemia & sickle cell disease are the important challenges for tribal populations in India. Many study demonstrated the prevalence of haemoglobinopathies in India & among tribes of India but limited data available from Baster tribal region. This study will further lightens the haemoglobinopathies among Baster region of Chhattisgarh state of India. **Methods:** It was an retrospective observational study, carried out in Late. BRKM Government Medical College, Dimrapal, Jagdalpur which was located at baster region of Chhattisgarh state of India aims to determine the prevalence of various hemoglobinopathies in Baster. Out of 421 suspected patient's screened for hemoglobinopathies by Capillary electrophoresis. Statistical Package for Social Sciences (SPSS) used for descriptive analysis. **Results:** Out of 421 cases, 276 were diagnosed with various type of hemoglobinopathies {49% has HbAS (sickle cell anaemia trait), 3% HbSS (sickle cell disease), 6% sickled beta-thalassemia & 8% HPFH (hereditary persistence of foetal hemoglobin)}. Non-tribal population has higher trends of sickled beta thalassemia 14 (8.28%), Hereditary persistence of foetal hemoglobin 26 (15.38%) and HbAS 122 (72.19%) as compare to tribal population but there was similar prevalence of HbSS among both of these groups. **Conclusion:** In India, hemoglobin disorders are the great threat for tribal population. As <10% of tribes residing in India and many were extinct. The non-tribal community has more prevent than tribal communities.

INTRODUCTION

Hemoglobinopathies are characterised by a group of single gene disorder associated with faulty haemoglobin (heme=iron; globin=protein) production, which is usually caused by defective production of the globin moiety of haemoglobin. The commonest type of hemoglobinopathies are HbD, HbE, HbS and thalassemia (1). The worldwide prevalence of hemoglobinopathies were 7% and approximately 60-70 million population with sickle cell disease. It was also estimated that 15 million population worldwide affected with thalassemia with 240 millions of carriers of beta-thalassemia (2). In India, the prevalence of beta-thalassemia ranged from 3-17% and other variant of hemoglobinopathies such as HbS was 4.3%, HbD (0.86%), and HbE was 10.9% (mostly prevalent in North Eastern region of India) (1).

Tribal population of India constitutes approximately 8.5 per cent of the total population of India. These Tribals can be broadly divided into several groups i) tribal populations in the North East, ii) Tea Garden tribal populations, iii) Tribal populations in central India, iv)Tribal populations in western India, v)Tribal population in eastern parts of Odisha and Andhra Pradesh, and vi) Tribal populations in south India (3).

This distinction is important because there are some variations in the nature, composition and clinical severity of various haemoglobinopathies in different tribal areas of the country. Tribal populations of North East predominantly show haemoglobin E (HbE) a structural haemoglobin disorder with variable combination of β thalassaemia and α thalassaemia genes (4-8). Tribals working in tea gardens in the North East show sickle cell haemoglobin (HbS) as the predominant haemoglobinopathy (9). In the tribal populations of central India and eastern parts of Odisha and Jharkhand, HbS emerges out as the predominant haemoglobinopathy (9). Many study demonstrated the prevalence of

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haemoglobinopathies in India & among tribes of India but limited data available from Baster tribal region. This study will further lightens the haemoglobinopathies among Baster region of Chhattisgarh state of India.

METHODS

Setup and Design

This study was carried out in Late. BRKM Government Medical College, Dimrapal, Jagdalpur which is a dense tribal region of Chhattisgarh state of India. It was an retrospective observational study, aims to determine the prevalence of various hemoglobinopathies in Baster. Before conducting the study an Institutional Ethical approval were sought.

Data Collection & Method of Testing

Data were collected from suspected cases of patient blood samples both from inpatient (Medicine, Surgery, Paediatrics, Orthopaedics and Obstetrics & Gynaecology) and outpatient department were collected. Test tube containing Ethylenediaminetetraacetic acid (EDTA) was used for collection of samples and was sent to Biochemistry department. The sample was centrifuge at 3500 rpm for 10 minutes. 150 to 250 µL of blood sample were used for analysis. Hemoglobin Maxi Kit (PN 2227) regent were used at pH 9.4. MINICAP system calculates the concentration (%) of each hemoglobin fraction. Normal and abnormal (variant) Hb are detected in the following order, δA'2 (A2 variant), C, A2/O-Arab, E, S, D, G-Philadelphia, F, A, Hope, Bart, J, N-Baltimore and H. 421 suspected patient's blood sample were collected from Late. BRKM Govt. medical College, Dimrapal, Jagdalpur and some private clinics for the screening of hemoglobinopathies from January 2018 to February 2019 were collected. Capillary electrophoresis (Minicap Sebia Flex Piercing) was used to determine the various parameters of hemoglobinopathies, which includes hemoglobin A_1 (HbA_1), hemoglobin A_2 (HbA_2), hemoglobin S (HbS), hemoglobin F (HbF) and hemoglobin C (HbC). Various parameters such as HbA_1: 95%-98%, HbA_2: 1.5%-3.5%, HbF: < 2% (age-dependent), HbC: Absent, HbS: Absent were taken as an reference range (10).

Statistical Analysis

Data were entered in Statistical Package for Social Sciences (SPSS) version 23 for Chicago Inc. Data related to hemoglobinopathies were reported as mean±SD (Standard Deviation) with 95% CI and differences in the mean levels between male & female as well as between tribal and non-tribal population was compared with unpaired student t-test and Chi square test was used for descriptive analysis. A priori p-value of 0.05 was used throughout the analyses and the results were considered statistically significant at $p<0.05$.

RESULTS

Out of 421 blood samples, 276 patients were found to be positive for various type of hemoglobinopathies in Baster district of Chhattisgarh state of India from January 2019 to December 2019. Predominantly female patients (62.31%) had higher incidence of hemoglobinopathies as compared to males. The mean±SD age of recognition of hemoglobinopathy of male patients was 19.45±13.19 years as compare to and female patients 25.36±14.48 years, ($p<0.001$). 38.76% (n-107) of patients belonged to the tribal community and rest were migrated from other state and district of Chhattisgarh. Among 38.76% of tribal patients, 62.61% were females ($p>0.9$). As demonstrated in Table-1, the commonest age group of diagnosis of hemoglobinopathy among male (33.65%) patients was 11-20 years as compare to females (29.07%) patients it was 21-30 years ($p>0.04$).

As illustrated in Figure-1, of 421 total suspected cases, 34% were normal, 49% has HbAS (sickle cell anaemia trait), 3% HbSS (sickle cell disease), 6% sickled beta-thalassemia & 8% HPFH (hereditary persistence of fetal hemoglobin). The prevalence of HbAS was commonest among age group 21-30 years while HbSS were more prevalent between first & second decade of life. The sickled beta-thalassemia and HPFH was more frequently observed between 11-20 year age group (Table-2). As we compared the various parameters of electrophoresis among the genders, we observed that, the median percentage difference of HbA_1 among male patients was (M [I-Q]) (45.35 [0.00-67.45]) as compare to

Table 1. Age-wise distribution of study groups

Age (years)	Male (n-104)	Female (n-172)	2 tail-significant
0-10	25.96%	13.95%	0.04
11-20	33.65%	25.00%	
21-30	22.12%	29.07%	
31-40	10.58%	15.70%	
41-50	3.85%	8.14%	
51-60	2.88%	6.40%	
61-70	0.96%	1.74%	

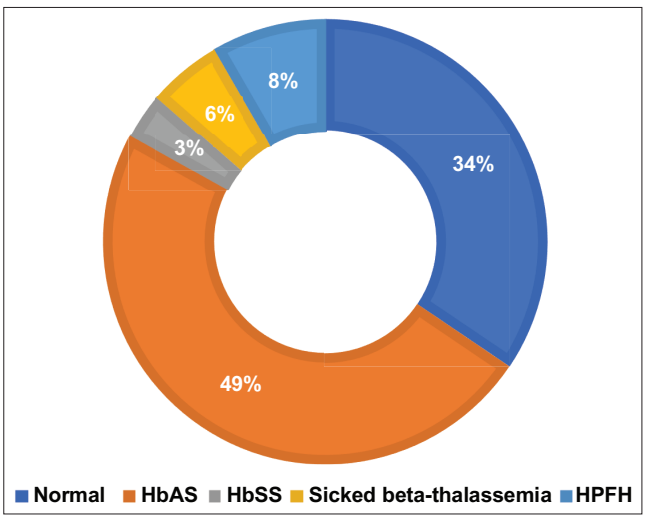

Figure 1. Distribution of types of hemoglobinopathies among the study population
HbAS (sickle cell anaemia trait), HbSS (sickle cell disease), HPFH (hereditary persistence of fetal hemoglobin)

Table 2. Age-wise distribution of hemoglobinopathies of Baster region

Age (years)	HbAS	HbSS	Sickled-beta thalassemia	HPFH	2 tail- significant
0-10	35 (12.68%)	05 (1.81%)	03 (1.09%)	08 (2.90%)	0.09
11 to 20	43 (15.58%)	05 (1.81%)	10 (3.62%)	20 (7.25%)	
21 to 30	59 (21.38%)	0.00	08 (2.90%)	06 (2.17%)	
31 to 40	32 (11.59%)	04 (1.45%)	01 (0.36%)	01 (0.36%)	
41 to 50	17 (6.16%)	0.00	01 (0.36%)	0.00	
51 to 60	14 (5.07%)	0.00	0.00	0.00	
61 to 70	04 (1.45%)	0.00	0.00	0.00	

HbAS (sickle cell anaemia trait), HbSS (sickle cell disease), HPFH (hereditary persistence of fetal hemoglobin)

female patients (M ([-Q]) (63.85 [0.00-94.4]); p<0.0001. The median percentage difference of HbF among male & female patients was (M [I-Q]) (1.2 [0.00-97.9]) & (M [I-Q]) (7.4 [0.00-74.4]); p<0.01, respectively. There was significant mean difference of HbS percentage between both gender; the difference was 29.41±19 in male and 47.55±25.31 in female (p<0.0001). The mean percentage difference of HbA_2 level in between male & female was 2.61±0.84 and 2.69±0.93 (p>0.4), respectively. Similarly, the mean percentage difference of HbC level were also found statistically non-significant.

As illustrated in Table-3 and Figure-2, Out of 276 patients, 150 (87.21%) female patients were diagnosed with HbAS as compare to 54 (51.92%) male patients. The HbSS were more common among male patients 08 (7.69%) as compare to females 06 (3.49%). Similarly Sickle-cell β-thalassemia & Hereditary persistence of foetal hemoglobin (HPFH) were also prevalent among male than female patients {14 (13.46%) vs. 09 (5.23%) & 28 (26.92%) vs. 07 (4.07%), respectively}; p<0.03. As we also observed (Table-4), non-tribal population has higher trends of sickled beta thalassemia 14 (8.28%), Hereditary persistence of foetal hemoglobin 26 (15.38%) and HbAS 122 (72.19%) as compare to tribal population but there was similar prevalence of HbSS among both of these groups.

We also observed, there was positive correlation between age with HbA1 (r = 0.283, p<0.0001), and negative correlation with HbF (r = -0.290, p<0.0001), HbS (r = -0.168, p<0.005). There was negative correlation was observed between gender and HbA1 (r = -0.406, p<0.0001), while positive correlation observed with HbS (r = 0.378, p<0.0001), and HbF (r = 0.15, p<0.01). The negative correlation were observed between HbA1 with HbS (r = -0.826, p<0.0001), and HbF (r = -0.672, p<0.0001).

Table 3. Gender-wise comparison of hemoglobinopathies of Baster region of Chhattisgarh

Characteristics	Female (172)	Male (104)	2 tail-significant
HbAS	150 (87.21%)	54 (51.92%)	0.03
HbSS	06 (3.49%)	08 (7.69%)	
Sickled-beta thalassemia	09 (5.23%)	14 (13.46%)	
HPFH	07 (4.07%)	28 (26.92%)	

HbAS (sickle cell anaemia trait), HbSS (sickle cell disease), HPFH (hereditary persistence of foetal hemoglobin)

Table 4. Comparison of hemoglobinopathies among tribal and non-tribals of Baster region of Chhattisgarh

Characteristics	Tribes (n-107)	Non-Tribes (n-169)	2 tail-significant
HbAS	82 (76.64%)	122 (72.19%)	0.4
HbSS	07 (6.54%)	07 (4.14%)	
Sickled-beta thalassemia	09 (8.41%)	14 (8.28%)	
HPFH	09 (8.41%)	26 (15.38%)	

HbAS (sickle cell anaemia trait), HbSS (sickle cell disease), HPFH (hereditary persistence of foetal hemoglobin)

DISCUSSION

In this study, the prevalence of hemoglobinopathies were predominantly higher among female patients as compare to male as it was also observed by Ajjack et al (11). Similarly, the prevalence among tribal community (n-107), most of patients were females. As observed by Balgir et al. the total percentage of tribal community in India was 8.6% and highly associated with hereditary hemolytic disorders (12). There was significant age (5.91 years) difference between both gender (p<0.04). The most common presented age group were 11-20 years in males while the age group of 21-30 years were predominant among female patients. There was also a positive correlation between age with HbA_1 while HbF, and HbS shown negative correlation. We are unable to find any study which correlated with these outcomes.

The prevalence of hemoglobinopathies was varies from states to states and country to countries. As we observed in Vadodara (Gujrat), the prevalence of HbAS 11.4%, HbSS 20% and sickled beta-thalassemia was 11.4 while 45.7% patients had beta thalassemia among 35 patients and 74.3% of them were males. (13) Similarly, In 2017, Niraj et al demonstrated, the prevalence of hemoglobinopathies in anaemic children in Ranchi (Bihar), where male children was more prevalent HbSS (14). In Karachi (Pakistan) 935 patients were diagnosed with various type of hemoglobinopathies. Among these patients 75.9% β-thalassemia, 6.7%, sickle/beta thalassemia, 3.9% with HbSS and 1.7% HbAS and the prevalence of these hemoglobin disorder were commonly

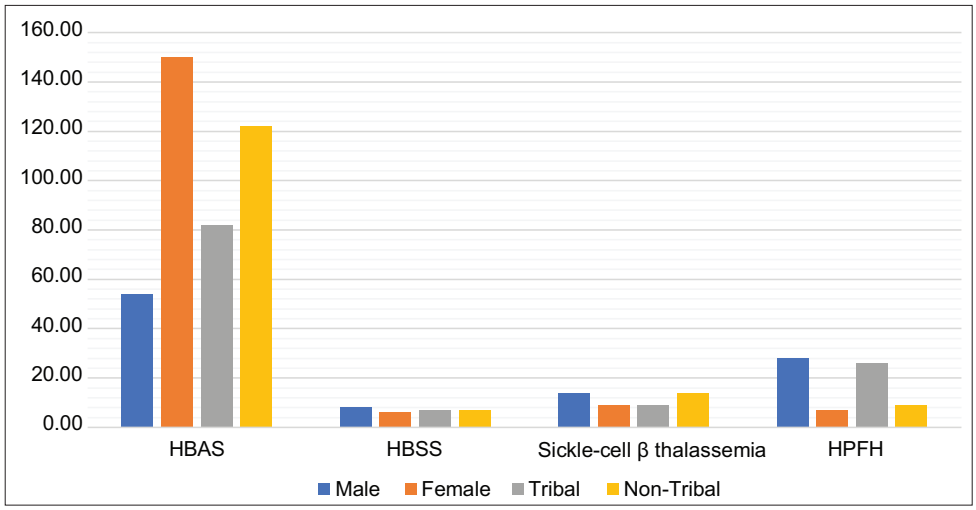

Figure 2. Gender & ethnic wise distribution of hemoglobinopathies of Baster region of Chhattisgarh state.
HbAS (sickle cell anaemia trait), HbSS (sickle cell disease), HPFH (hereditary persistence of foetal hemoglobin)

observed with female patients as compare to males.(15) Similarly, In 2012, Mondal et al demonstrated the prevalence of hemoglobinopathy in West Bengal, India, and observed that, the prevalence of hemoglobinopathy were higher among females as compare to males and beta-thalassemia (major& Minor) were more prevalent than other types of hemoglobin disorders. (16) As we observed in our study sickle cell trait (HbAS) was more prevalent among female patients. The prevalence of HbAS was 150 (87.21%) out of 172 female patients and even it was more common as compare to male patients 54 (51.92%) but the prevalence of HbSS, sickled beta thalassemia and HPFH were more prevalent among male patients (7.69%, 13.46% & 26.92%, respectively) as compare to female patients.

As demonstrated by various authors, many tribal community in India was recognised to have various type of hemoglobinopathies and the commonest recognizable disease were sickle cell anemia & beta-thalassemia. (17-19) These diseases are hereditary or genetic in nature and tend to run in the families and it is mostly due to consanguineous marriages in the tribal community. (20) This could be the result for development of hemoglobinopathies among these tribal community in India which can be due to genetic mutation of both diseases and possess with high prevalence of sickle-beta thalassemia. But in our study, non-tribal community were more prevalent to hemoglobinopathies and even the beta-thalassemia as compared to tribes of baster. As it was observed, out of 276 diagnosed cases, 169 patients were belong to non-tribal community and the hemoglobinopathies were more prevalent among these community rather than tribes of baster. In 2015, Thakur et al. demonstrated the prevalence of hemoglobinopathies among various non-tribal districts of Chhattisgarh state and observed that the prevalence of HbAS were more common than HbSS in four major district of Chhattisgarh state of India. While as demonstrated by Balgir et al (1), The prevalence of sickle cell anaemia and beta-thalassemia in tribes of Chhattisgarh was 0.9%-22.5% & 0-21%, respectively, which was comparable from neighboring state (Madhya Pradesh) but as we observed in our study, although sample size was small but the prevalence of HbSS was 6.54% and sickle beta thalassemia (8.41%) while we unable to isolated any case of beta-thalassemia.

CONCLUSION

In India, hemoglobin disorders are the great threat for tribal population. As <10% of tribes residing in India and many were extinct. Majority of hemoglobinopathies possess with various degree of anaemia but we unable to provide any hemoglobin data which was the very important limitation of our study. As we observed, the prevalence of HbAS was predominant in our study following hereditary persistence of foetal hemoglobin then sickled beta-thalassemia. The non-tribal community has more prevent than tribal communities. It is now very important to diagnosed these diseases earliest to improve the outcome as these disease no longer called the disease of tribes.

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REFERENCES

1. Balgir RS. Public Health Challenges of Hemoglobinopathies in Tribal Land in India. A Necessity of Introducing Genetic Services in the Health Care Systems Approach. BBB. 2014; 2 (3):489-503.
2. Weatherall DJ, Clegg JB. Inherited haemoglobin disorders: an increasing global health problem. Bull World Health Org. 2001; 79:1-15.
3. Census of India 2011, Office of the Registrar General and Census Commissioner. Ministry of Home Affairs, Govt. of India. (accessed on feb 3, 2020). Available from: http;//www.censusindia.gov.in.
4. Das BM, Chakravartti MR, Delbruck H, Flatz G. High prevalence of haemoglobin E in two populations in Assam. Human genetic. 1971;12:264–266.

5. Flatz G, Chakravartti MR, Das BM, Delbruck H. Genetic survey in the population of Assam. I. ABO blood groups, glucose6phosphate dehydrogenase and haemoglobin type. Hum Hered. 1972;22:323–330.
6. Das BM, Deka R, Flatz G. Predominance of the haemoglobin E gene in a Mongoloid population in Assam (India) Human genetic. 1975;30:187–191.
7. Das BM, Deka R, Das R. Haemoglobin E in six populations of Assam. J Indian Anthropol Soc. 1980;15:153–156.
8. De M, Halder A, Podder S, Sen R, Chakrabarty S, Sengupta B, et al. Anemia and hemoglobinopathies in tribal population of Eastern and North eastern India. Hematology. 2006;11:371–373.
9. Bhatia HM, Rao VR (eds.) Genetic atlas of the Indian tribes. ICMR. Mumbai: Institute of Immunohematology 1986.
10. Fred F. Ferri (2005) *Ferri's Clinical Advisor: Instant Diagnosis and Treatment*, 2005 Edition, Baylor University Medical Center Proceedings, 18:4, 424, DOI: 10.1080/08998280.2005.11928109
11. Ajjack EA, Awooda HA, Abdalla SE. Haemoglobin Patterns in Patients with Sickle Cell Haemoglobinopathies. *International Journal of Hematological Disorders, 2014: 1(1), 8-11*
12. Balgir RS. Blood Disorders: 16-24 Chapters. Section 3. In: India: Health and Human Development Aspects. Merrick Joav (Ed). Nova Science Publishers Inc. New York. 2014; 309-411.
13. Shah SJ, Chauhan SC, Rathod HK, Patel AB, Sharma VY. A profile of cases of hemoglobinopathies at a medical college. NJMR Volume 2 Issue 2 Apr – June 2012.
14. Niraj MK, Prasad P. Detection of Hemoglobinopathies in Anemic Children by HPLC method-A Hospital Based Study. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) Volume 16, Issue 6 Ver. VIII (June. 2017), PP 73-77.
15. Shabbir S, Nadeem M, Sattar A, Ara I, Ansari S, Farzana T et al. Type and frequency of hemoglobinopathies, diagnosed in the area of Karachi, in Pakistan. Cogent Medicine. 3. 10.1080/2331205X.2016.1188875.
16. Mondal B, Maiti S, Biswas BK, Ghosh D, Paul S. Prevalence of hemoglobinopathy, ABO and rhesus blood groups in rural areas of West Bengal, India. J Res Med Sci. 2012 Aug; 17(8): 772–776.
17. Thakur S, Sharma R, Raw SN. Incidence of Thalassemia and Sickle Cell Disease in Chhattisgarh, Central India: Using Hardy Weinberg Equations. J Mol Genet Med 2015;9: 155.
18. Kamble M, Chatruvedi P. Epidemiology of sickle cell disease in a rural hospital of central India. Indian Pediatr. 2000;37:391-396.
19. Mohanty D, Colah RB, Gorakshakar AC et al. J Community Genet 2013;4:33.
20. Steinberg MH, Forget BG, Higgs DR, Nagel RL. Disorders of Hemoglobin: Genetics, Pathophysiology, and Clinical Management J R Soc Med. 2001 Nov; 94 (11):602-603.