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Prevalence of hemoglobinopathies in different regions and castes of Uttar Pradesh, India -A hospital based study

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ABSTRACT

Background: Thalasemia and other hemoglobinopathies are found in all the states of India and their prevalence is quite variable. In Uttar Pradesh very few studies are found which explore the spectrum of hemoglobinopathies. There is no such study which identifies the geographic distribution of high-risk communities with frequencies of hemoglobinopathies. **Aim:** Present study was carried out to determine the prevalence of hemoglobinopathies in different regions and castes of Uttar-Pradesh (UP) state. **Materials and Methods:** This is a preliminary community based cross-sectional, hospital based study, conducted at King George's Medical University, Lucknow, Uttar- Pradesh. Subjects aged between 18 to 65 years were enrolled for sampling. The anticoagulated blood was used for performing CBC (complete blood count), and hemoglobin electrophoresis to measure hemoglobinopathies. **Results:** The present study revealed higher(28/194;19.5%,$p<0.05$) prevalence of hemoglobinopathies in Lucknow district as compared to other districts of Uttar-Pradesh and Brahmin caste having high frequency (33/112;29.5%) followed by Jaiswal (3/13;23.1%) and Arora (2/9;22.2%). **Conclusion:** The data regarding prevalence and distribution can be useful in prevention and management of various hemoglobinopathies which play a vital role in the hospital blood bank as well as in the formulation of transfusion policies.

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INTRODUCTION

India has multiple geographical, ethnic, religious and language divisions.[1] Traditionally, marriages are within these subdivisions only resulting in difficulties in estimating the burden of genetic diseases at local and national level. In India, the gene frequency of hemoglobinopathies is 4.2%, with a population over 1 billion and over 12000 infants born each year have a clinically significant hemoglobinopathies.[2] According to world health organization (WHO), 5% of the world population is a carrier for Hemoglobin disorders.[3] Within this overall disease classification, a 1989 WHO Working Group on guidelines for the control of haemoglobin disorders estimated a 3.9% carrier frequency for β -thalasemia in India, encompassing all types of β -thalasemia trait.[4]

In various parts of India, the prevalence of β-Thalasemia is different: 6.5% in Punjab, 8.4% in Tamilnadu, 4.3% in south India, and 3.5% in Bengal. β- Thalasemia has a high prevalence in some communities, such as Sindhi, Luvana, Tribes, and Rajputs. The incidence of β-Thalasemia in Gujarat is 10% to 15%.[5] In the studies from north India, major groups of Thalassemics from Uttar Pradesh (UP) are the migrant ethnic populations of Punjab and Sindh origin.[6-10]

Normally, the variation of Thalasemia trait and sickle cell hemoglobinopathies in India is between 3-17% and 1-44% respectively. Approximately 30 million Indians are carriers of β-Thalasemia and 7000 babies with β-Thalasemia are born every year. In different ethnic groups, the variation in carrier rate is between 0%-17%.[11]

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Although Thalasemia and other hemoglobinopathies are found in all the states of India and their prevalence is quite variable, very few studies are found in Uttar-Pradesh which explores the spectrum of hemoglobinopathies. There is no such study, which identifies the geographic distribution of high-risk communities with frequencies of hemoglobinopathies.

Therefore preliminary hospital based study was carried out to determine the Prevalence of hemoglobinopathies in different regions and castes of Uttar-Pradesh state.

MATERIALS AND METHODS

This is a preliminary community based cross-sectional study conducted in the Department of Physiology with the collaboration of P.G. Department of Pathology at Kings George's Medical University (KGMU), Lucknow, U.P. between Sept. 2011 to Dec.2013. People of age group between18 to 65 years were randomly selected from Out-patient-department (OPD) on the basis of inclusion and exclusion criteria (included the suspected cases of hemolytic anemia without any systemic /chronic infection and drug abuse). An informed consent was obtained from the participants prior to the commencement of screening. The prepared questionnaires were provided to all the participants containing information related with age, sex, resident, nationality, educational qualification, occupation and financial status. The study was approved by Institutional ethics committee Kings George's Medical University, Lucknow, UP, India.

Sample collection and Preparation

Six ml venous blood was collected in EDTA vials and few drops of fresh whole blood were put on slides for blood group investigation .The anticoagulated blood was used for performing CBC (complete blood count) and hemoglobin electrophoresis. Haemolysate was prepared from whole blood by using saline and carbon tetra chloride with a concentration of 1.6 g/dl to 2.2 g/dl for hemoglobin electrophoresis.[12]

Complete Blood Count

Hematological indices were measured using Sysmex MX– 4 fully automated blood cell counter, which was calibrated with commercially available controls. The sickling test was performed using freshly prepared sodium metabisulphite solution as a reducing agent. [13]

Electrophoresis

Agarose gel electrophoresis was performed using Tris- EDTA –borate buffer at alkaline pH (8.6). The electrophoresis pattern was visualized by staining the film with a Ponceau S stan. This pattern was then quantified using a densitometer (Beckman Coulter) at 600 nm wavelength.[12,14]

Statistical Analysis

The collected data was checked and entered on Microsoft Excel Worksheet. Frequencies and percentages were used to describe categorical variables. The frequencies of nominal variables were compared by using the chi-square test. A p-value of ≤ 0.05 was considered statistically significant. The Indian society is fragmented into thousands of caste groups and more than 500 tribal groups including 75 primitive communities (Indian STs, govt. doc, 2011).

RESULTS

Total 1180 subjects were screened for assessing hemoglobinopathies and among them, 143 subjects were detected for hemoglobinopathies with its prevalence being 12.1%. The subjects belonged to different districts of UP state. Prevalence was analysed on the basis of presence or absence of hemoglobinopathy in the screened anemic (Hb<7 gm%) cases. The results were tabulated as follows:

DISCUSSION

The Indian population comprises numerous castes and communities, each revealing different genetic traits. Some hemoglobinopathies are also thalasemias but most are not. The distribution of beta-thalasemia is not uniform in Indian subcontinent. [15-20] The highest frequency of beta thalasemia trait is reported in Gujarat (10-15%), followed by Sindh (10%), Punjab (6.5%), Tamil Nadu (8.4%) and Maharashtra.[20, 21]

In our study, total screened subjects belonging from UP were 1180 in which 143 (12.1%) were having hemoglobinopathies. Ambekar et al. reported the frequency of hemoglobinopathies in Western Maharashtra stating 106 (26.5%) out of 400 subjects showing the presence of hemoglobinopathies. [18] Chopra et al. revealed that out of 1032 participant, 258 (25%) cases had abnormal hemoglobin.[19] The issue of hemoglobinopathies in India is aggravated by the diversity of population. The gene frequency for various hemoglobinopathies varies across different regions of India. The rates of fertility, literacy and consanguinity in marriages are also diversified.

However, Patel J et al. reported the prevalence of hemoglobinopathies in Gujarat, mentioning that out of 428 subjects, 153(35.7%) had hemoglobinopathies [20] while their another study in year 2011 found higher prevalence

Table 1: Prevalence of hemoglobinopathies

Variables	No of subjects	Subjects with Hemoglobino-pathy	Prevalence (%)	p-value
Age in years				
<20	86	20	23.3	0.005*
20-29	396	51	12.9	
30-39	402	45	11.2	
40-49	296	27	9.1	
Gender				
Male	804	110	13.7	0.01*
Female	376	33	8.8	
Income				
HIG	19	1	5.3	0.002*
MIG	814	82	10.1	
LIG	347	60	17.3	
Education				
Illiterate	101	27	26.7	0.0001*
Middle	226	36	15.9	
High School	273	40	14.7	
Intermediate	233	16	6.9	
Graduate	175	13	7.4	
Above graduate	172	11	6.4	
Socio-economic status				
I	349	62	18.0	0.0001*
II	193	32	16.6	
III	262	29	11.1	
IV	274	12	4.0	
V	102	8	7.8	
Family size				
<6	542	52	9.6	0.01*
>=6	638	91	14.3	

Table 2: Area-wise prevalence of hemoglobinopathies

S. N.	District (n=No. of subject)	No.of subjects with Hemoglobinopathies (n=143)	Prevalence %
1	Agra (n=3)	0	0.0
2	Aligarh (n=1)	1	0.70
3	Allahabad (n=43)	6	4.19
4	Ambedkar Nagar (n=21)	7	4.89
5	Amethi (n=7)	2	1.39
6	Azamgarh (n=25)	4	2.79
7	Badaun (n=1)	1	0.70
8	Bahraich (n=43)	5	3.49
9	Baliya (n=7)	0	0.0
10	Balrampur (n=10)	0	0.0
11	Banda (n=8)	1	0.70
12	Barabanki (n=44)	8	5.59
13	Bareilly (n=16)	0	0.0
14	Basti (n=45)	8	5.59
15	Bijnaur (n=3)	1	0.70
16	Buland Shahar (n=9)	0	0.0
17	Chanduali (n=5)	1	0.70
18	Devaria (n=7)	1	0.70
19	Etawah (n=2)	0	0.0
20	Faizabad (n=38)	10	6.99
21	Farrukhabad (n=2)	0	0.0
22	Fatehpur (n=19)	3	2.09
23	Ghazipur (n=14)	1	0.70
24	Gonda (n=31)	7	4.89
25	Gorakhpur (n=31)	4	2.79
26	Hardoi (n=42)	6	4.19
27	Jaunpur (n=35)	5	3.49
28	Jhansi (n=2)	0	0.0
29	Kannauj (n=7)	0	0.0
30	Kanpur City (n=36)	7	4.89
31	Kanpur Dehat (n=3)	2	1.39
32	Kaushambi (n=8)	0	0.0
33	Kushi Nagar (n=16)	6	4.19
34	Lakhimpur (n=54)	6	4.19
35	Lucknow (n=194)	28	19.58
36	Maharaj Ganj (n=16)	4	4.79
37	Mainpuri (n=3)	0	0.0
38	Mau (n=7)	1	0.70
39	Meerut (n=4)	1	0.70
40	Muzaffar Nagar (n=15)	3	2.09
41	Pilibhit (n=14)	3	2.09

up to 38.97%.[21] Another study by Panda A et al. based on West Bengal population illustrated to prevalence of hemoglobinopathies was 20.47%.[22] Sachdev et al. reported 327 (12.6%) hemoglobinopathies out of 2600 subjects.[23] This finding is consistent with our result.

Contrary to our result, a study of Bangladesh in year 2012 reported that, out of 600 screened individuals, 253 (42.2%) were found normal and 347 (57.8%) had one or the other form of hemoglobinopathies.[24] This frequency of hemoglobinopathies is higher in comparison to our findings. Most of the hemoglobinopathies belongs to the age group <20 years and the second common age group 20-29 years. It may be because of the average life span of a thalasemia patient in India is approximately 20-25years. A study by Jain et al. observed that 54.15% patients were of age group 13-36 years, 39.88% of age 0-12 years.[25] This finding is supported by our study. However, Uddin et al., (2012), observed to majority of hemoglobinopathy cases belong to neonatal to childhood period (0–15 years) followed by reproductive age group (16–45 years) and only a few cases of old age (≥46years) were detected in Bangladesh. [24] A work done on blood donors found that the age of the subjects with hemoglobinopathies were 21-30 years. [21] All these studies revealed about varying hemoglobinopathy frequency according age group as well as geographical area. Our findings are highlighted to the facts of hemoglobinopathies. Patients have increased mortality and very few of them survive beyond the fifth decade.

The present study (Table 1) revealed higher prevalence of hemoglobinopathies in males 110/804(13.7%) as compared to females 33/376(8.8%). A study by Chopra and co-workers reported that out of 258 abnormal cases, 136 (53%) were males and 122 (47%) were females[19] and Patel et al. found 62% male 37.9% female having hemoglobinopathies.[20] Rao et al.,(2010) observed 32.4% males and 67.6% females were suffering from hemoglobin disorders[26] while Uddin et al., (2012) reported an equal incidence

Table 3: Cast-wise prevalence of Hemoglobinopathies

S.No.	Sub-castes	No. of subjects	No. of Haemoglobinopathies	Prevalence of Haemoglobinopathies
1	Agarwal	28	2	7.1
2	Yadav	107	11	10.3
3	Ahmed	16	2	12
4	Ali	17	1	5.9
5	Ansari	20	1	5.0
6	Arora	9	2	22.2
7	Badhai	14	2	14.3
8	Balmiki	12	1	8.3
9	Bengali	11	1	9.1
10	Jaiswal	13	3	23.1
11	Brahman	112	33	29.5
12	Bedi	9	1	11.1
13	Harijan	55	9	16.4
14	Chauhan	10	1	10.0
15	Dhanuk	10	1	10.0
16	Gadariya	14	2	14.3
17	Gautam	13	1	7.7
18	Gupta	85	4	4.7
19	Jaat	11	1	9.1
20	Jain	15	1	6.7
21	Jatav	14	2	14.3
22	Kahar	15	1	6.7
23	Kashyap	25	3	12.0
24	Kayasth	36	6	16.7
25	Kewat	8	1	12.5
26	Khan	19	1	5.3
27	Kurmi	72	6	8.3
28	Lodhi	19	2	10.5
29	Maurya	23	3	13.0
30	Paasi	67	9	13.4
31	Paal	34	2	5.9
32	Rajbhar	19	2	10.5
33	Thakur	109	11	10.1
34	Sekh	12	1	8.3
35	Sikh	14	2	14.3
36	Sonar	21	2	9.5
37	Sunni	26	4	15.4
38	Others	56	5	8.9

of hemoglobinopathies in both males and females. [24] Considering our result, it may be due to difference in sex predilection to hemoglobinopathies and more pronounced difference in the type of hemoglobinopathies acquired within a geographical area or males are more aware towards their health as compared to females.

In our study (Table 2) Lucknow district had shown highest frequency of hemoglobinopathy 28/194(19.5%), followed by Faizabad 10/38 (6.99%), Ambedkar Nagar 7/21(4.89%), Banda 1/8(4.89%), Allahabad 6/43(4.19 %) and Bahraich 5/43(3.49%). Aligarh, Badaun, Pilibhit, and Sant Kabir Nagar had shown lower frequency of hemoglobinopathies. This difference might be due to the local residents of Lucknow attending the KGMU-OPD who were more in number than those residing in rural areas.

The present study revealed the prevalence of hemoglobinopathies according to caste (Table 3). Brahmin caste having high frequency 33/112 (29.5%) followed by Jaiswals 3/13(23.1%) and Arora 2/9(22.2%). The prevalence of hemoglobinopathies was almost similar among Kayasth, SC and Sunni. Badhai, Bedi, Gadariya, Jatav, Passi, Sikh, Kewat, Kashyap, Thakur, Yadav, Ahmed, Rajbhar have <15% and the remaining castes showed ≤10% prevalence. This might be due to higher population of Brahmins as compared to others reported to the hospital.

A study of Odisha (Orissa) state by Bhasin MK et al., 1994 reported that hemoglobinopathy is confined mostly to scheduled tribes(ST) or scheduled castes(SC) as compared to general caste. [27] Another study of Orissa by RS Balgir (2005) observed that majority of hemoglobinopathic patients belong to general castes for sickle cell disorders (64.6%), β-thalasemia (79.6%) and other hemoglobinopathies (91.3%). [8] This may be due to breeding isolation of the people from the general stream and strictly following the tribal endogamy.

CONCLUSION

Our study was an attempt to study the prevalence of hemoglobinopathies in different regions and caste of Uttar Pradesh. The data regarding prevalence and distribution can be useful in prevention and management of various hemoglobinopathies which may play a vital role in the hospital blood bank as well as in the formulation of transfusion policies. Adequate measures and screening procedures should be performed concurrently. Thus, it can reduce the possibility of hemoglobin disorders of offspring, mental and physical trauma of affected patients and socio-economic burden of the family.

This % data does not reflect the exact status of hemoglobinopathies in general population since this is a hospital based study. Further large scale population based studies are needed for real status of hemoglobinopathies in different caste and geographical area.

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Authors Contribution:
Dr. Pratima Verma and Akhilesh Krishna collected the samples and carried out all the experimental work. Over all supervision and Hypothesis was generated by Dr. Archana Ghildiayal. Dr. Ashutosh Kumar guided and supervised the experimental work of the study. Dr. Dileep Verma and Dr. Sunita Tiwari helped in the data management and statistical analysis. Dr. Shraddha Singh guided the screening of subjects and supervises all the work done in the study. All the authors were equally involved in drafting and finalizing the manuscript.

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