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Prevalence of Hemoglobin E in Nine Populations of Northeast India

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ABSTRACT

Background

Hemoglobin E (Hb E) is the most common hemoglobin variant in Southeast Asia as well as in Northeast India. Frequency of Hb E is examined among some population groups of Northeast India.

Methods

Nine endogamous groups, from different parts of Northeast India, were studied. Blood samples were examined in the laboratory following capillary electrophoresis method (SEBIA).

Results

Among the studied nine populations. highest frequency of Hb E (0.4099) is found among the Lyngam Khasi, whereas its lowest frequency (0.0178) is found among the War Khasi. This gene frequency was found to be low in six populations out of nine. Higher gene frequency is recorded in two Austro-Asiatic groups namely, the Lyngam and Garo, and one Tibeto-Burman Group namely, the Rabha.

Conclusion

Higher Hb E gene frequency in these groups may be due to founder effect or local inbreeding.

KEYWORDS: Abnormal hemoglobin, Hb E, Endogamous groups, Northeast India.

INTRODUCTION

Hereditary disorder forms of anaemia are immensely common and affected persons are numbered in millions. Such hereditary disorders may be broadly looked into two aspects: biological and social. One of the important interests in the fields of the population genetics is to understand the biochemical structure and epidemiological problems of population distributions of abnormal haemoglobins. Hemoglobin E (Hb E) is the most popular hemoglobin variant in Southeast Asia as well as in Northeastern part of India. It is an abnormal hemoglobin with a single point mutation in which glutamic acid is replaced by lysine at position 26 of the beta globin chain.

Hb E is identified as most common abnormal hemoglobin in Southeast Asia. Reasons behind the high frequency of Hb E gene in this area are possibly the cumulative effect of selection and normal physical fitness of its carriers (Deka et al. 1988). Some populations of the Tibeto-Burman speaking Bodo ethnic group residing in Assam have shown the highest frequency (0.64) of the Hb E gene (Deka et al. 1988), so far in the world. Das et al. (1991)

reported the prevalence of Hb E gene frequency in three endogamous populations (Poliya, Deshi and Tiyor) of the northern part of West Bengal, who are offshoots of the Bodo group.

Reports on the prevalence of Hb E in Northeast India were mainly from the states of Assam and Meghalaya and Manipur that too was not complete and there are meager reports from rest of the Northeastern states like Arunachal Pradesh, Nagaland, Mizoram, Tripura etc. (Singh et al. 2010). In this study prevalence of Hb E is examined among nine population groups of Northeast India.

MATERIALS AND METHODS

Altogether 1839 subjects were recruited cross-sectionally from nine populations (War Khasi=170, Bhoi Khasi=201, Khynrium=203, Lyngam=222, Garo=209, Pnar=301, War Jaintia=105, Rabha=227 and Angami Naga=201). Unrelated (belonging to distinct lineages) healthy individuals were chosen. Informed consent was obtained. Six ml. of intravenous blood sample was obtained in EDTA tubes and sent on ice to the DNA laboratory of Northeast Regional Centre of Anthropological Survey of India, Shillong. Detection of Hb E was done by using SEBIA capillary electrophoresis.

Study Population

War Khasi

The War Khasi form a part of Khasi tribe. They are mainly concentrated along the southern slopes of the districts of the East Khasi Hills, Meghalaya. The war Khasi have their own dialect, which is Austro-Asiatic. They are an endogamous scheduled tribe and having a number of exogamous clans (kur). Monogamy is the rule of marriage and polygynous marriage is a rare. The rule of residence after marriage is matrilocal and they follow matrilineal system. In the present study War Khasi blood samples were collected from Tyrna and Tyniar village of East Khasi Hills district, Meghalaya.

Bhoi Khasi

The Bhoi Khasi refers to those groups of Khasi people who live in the lowland. The Bhoi Khasi distributed in about 30 villages in Nongpoh sub-division of East Khasi Hills, Meghalaya. The dialect of the Bhoi Khasi, which is known as ‘Bhoi’ is a form of the Khasi language. Bhoi Khasi is matrilocal and an endogamous community. They have matrilineal system of social system and they are Austro-Asiatic-speaking population. Bhoi Khasi blood samples were collected from Ri Bhoi district, Meghalaya.

Khynrium

The Khynrium Khasi of Meghalaya refer to the people staying in the uplands or Khasi Hills. They speak a distinct language of Mon-Khmer and have adopted the Roman script for writing. The rule of residence after marriage is also matrilocal and matrilineal system of community. The status of Khynrium Khasi women appears to be high, mainly because of the rule of inheritance and the comparative freedom in selecting spouse. They are Austro-Asiatic-speaking population. Khynrium Khasi blood samples were collected from Pepba village of East Khasi Hills district, Meghalaya.

Lyngam

The origin of the Lyngam of Meghalaya is a result of their geographic distribution. Earlier analysis of ethno-historic, linguistic and demographic data suggested the neighbouring Khasi and Garo as the putative parental population(s) of Lyngam. Lyngam are living in the western portion of the Khasi Hills, Meghalaya. They speak a dialect which is a mixture of the Khasi and the Garo. Lyngam follows clan exogamy marriage and matrilineal inheritance social system. They are Austro-Asiatic-speaking population. Lyngam blood samples were collected from Umdong village of Mawsynrum of West Khasi Hills district, Meghalaya.

Garo

The Garo is a matrilineal Tribe of Garo Hills district of Meghalaya. Descent and inheritance properties are through the mother side. The Garo belong to the family of the Tibeto-Burman linguistic group. Among the Garo, cross-cousin marriage is the rule, be it a first cousin or a classificatory one. Monogamous marriage is the usual practice among them but polygyny is also allowed. Garo blood samples were collected from Pillangkata village of Ri Bhoi district, Meghalaya.

Pnar

Pnar are mainly distributed in the Jaintia Hills District of Meghalaya. They are one of the major sub groups of Khasi population. Pnar are sometimes called as jaintia or Syentang. They belong to matrilineal society and their social, cultural and economic set up is based on matrilineal and matrilocal traits. The Jaintia speak Austric language belonging to Mon-khmer group. The origin of the Jaintia kingdom is unknown. Pnar blood samples were collected from Nartiang village of West Jaintia Hills district, Meghalaya.

War Jaintia

War Jaintia are living in the southern part of the Jaintia Hills District, Meghalaya. They are inhabiting those stretch of land. They prefer to call themselves as War Jaintia or simply Wars. Like Pnar, the War Jaintia belong to matrilineal society and their social, cultural and economic set up is based on matrilineal and matrilocal traits. The War Jaintia speak Austric language belonging to Mon khmer group. War Jaintia blood samples were collected from Darrang village of West Jaintia Hills district, Meghalaya.

Rabha

The Rabha are a scheduled tribe in the valley of Assam, distributed in Kumrup, Goalpara and Darrang district. A section of the Rabha also inhabits the northern region of the East Garo Hills district of Meghalaya. The Rabha speak Bodo language of the Tibeto Burman family. They are patrilocal and patrilineal. Rabha blood samples were collected from Boko area of Kamrup district, Assam.

Angami Naga

Angamis are a dominant Naga tribe in the state of Nagaland. The Angami country broadly forms the present-day Kohima district of Nagaland. They are dependent upon agriculture for their subsistence economy. Angami Naga are patrilineal. In the present study

Angami Naga blood samples were collected from Zadima and Merima village of Kohima district, Nagaland.

RESULTS

Results are furnished in Table 1. Near about one fourth (23.42 %) of the Lyngam show the prevalence of Hb E. High prevalence of Hb E is also recorded among the Garo (15.31 %) and Rabha (4.85 %). Whereas, among the Bhoi Khasi (1.49 %), Khynrium (0.99 %), War Jaintia (0.95 %) and Angami Naga (0.99 %) very few of them are with Hb E. However, among the War Khasi and Pnar none of them is with Hb E. It is interesting to note that half of the Rabha subjects are heterozygous (50.22 %). While, among the Lyngam (35.14 %), Garo (28.23 %) and War Jaintia (26.66 %) also a high frequency of heterozygous are noticed. Among the Bhoi Khasi (20.90 %) and Khynrium (19.70 %) a moderate frequency of heterozygous is recorded.

It is apparent from Table 1 that among the studied populations highest frequency of Hb E (0.4099) is found among the Lyngam Khasi, which is followed by the Rabha (0.2996), Garo (0.2943) and War Jaintia (0.1429) respectively. In the Bhoi Khasi (0.1194), Khynrium Khasi (0.1084), Pnar (0.0631), Angami Naga (0.0522) and War Khasi (0.0178) a low frequency of Hb E allele is recorded.

Table 1: Allelic frequency of E Hemoglobin in nine populations of Northeast India.

Population	**No**	**Hemoglobin Type/Genotype**			**E gene frequency**
		AA	**AE**	**EE**	
War Khasi	170	165 (97.06)	5 (2.94)	-	0.0178
Bhoi Khasi	201	156 (77.61)	42 (20.90)	3 (1.49)	0.1194
Khynrium Khasi	203	161 (79.31)	40 (19.70)	2 (0.99)	0.1084
Lyngam Khasi	222	92 (41.44)	78 (35.14)	52 (23.42)	0.4099
Garo	209	118 (56.46)	59 (28.23)	32 (15.31)	0.2943
Pnar/Jaintia	301	263 (87.38)	38(12.62)	-	0.0631
War Jaintia	105	76 (72.38)	28 (26.66)	1 (0.95)	0.1429
Rabha (Assam)	227	102 (44.03)	114 (50.22)	11 (4.85)	0.2996
Angami Naga	201	182 (90.55)	17 (8.46)	2 (0.99)	0.0522

Note: Figures in parenthesis indicate percentage values

When we compared the results of the present study with other populations of Northeast India, the highest frequency of Hb E is found among the Mishing (0.6000), which is followed by the Boro-Kachari (0.5934), Rabha (0.5352), Kachari (0.5069) and the Garo (0.4963). The Lyngam

(0.4099), Rabha (0.2996) and Garo (0.2943) of the present study are characterized with high frequency of Hb E. Among the others a low frequency of Hb E is found (Table 2).

Table 2: Frequency of hemoglobin E in Northeast India

Population		**Location**	**N**	**Hb E**	**Reference**
Austro-Asiatic	Khasi	Shillong	140	0.2250	Flatz et al. 1972
	Khasi	Cherrapunji	157	0.0223	Saha 1990
Tibeto-Burman	Bodo-Kachari	Assam	241	0.5934	Deka et al. 1988
Chutiya		Assam	72	0.2986	Deka et al. 1987
Garo		Assam	135	0.4963	Das et al. 1980
Garo		West Bengal	21	0.0476	Mukherjee et al. 1987
Kachari		Assam	1082	0.5069	Deka 1981
Karbi		Assam	110	0.2273	Deka et al. 1988
Mishing		Assam	25	0.6000	Deka et al. 1988
Rabha		Assam	128	0.5352	Das et al. 1980
Rabha		West Bengal	90	0.0611	Mukherjee et al.1987
Rajbanshi		Assam	266	0.3045	Das et al. 1980
Rajbanshi		West Bengal	63	0.1032	Mukherjee et al. 1987
Sonowal		Assam	106	0.3962	Deka et al. 1988
Tiwa (Lalung)		Assam	114	0.4474	Das et al. 1980
Mixed		Cherrapunji	24	0.3750	Saha 1990
Lepcha		West Bengal	215	0.0209	Saha et al. 1987
Naga-Kuki-Chin	Naga (Rengma)	Nagaland	148	0.0068	Saha 1990
	Hmar	Assam	81	0.0123	Saha 1990
	Mikir	Assam	241	0.2116	Das et al. 1980
	Meiteis	Manipur	307	0.0814	Singh et al. 1986
Arunachal Pradesh	Adi (Gallong)	Arunachal Pradesh	113	0.1814	Saha 1990
	Adi (Myiong)	Arunachal Pradesh	42	0.0833	Saha 1990
	Adi (Other)	Arunachal Pradesh	60	0.1000	Saha 1990
	Nishi (Dafla)	Arunachal Pradesh	216	0.0741	Saha 1990
	Apatanis	Arunachal Pradesh	79	0.0643	Saha 1990
	Others	Arunachal Pradesh	58	0.0690	Saha 1990

Kam-Tai Ahom		Assam	620	0.3516	Das et al. 1975
Indo European, Assam	Brahmin	Assam	110	0.0495	Deka et al. 1988
	Kalita		120	0.1208	Deka et al. 1988
	Kalibarta		101	0.1337	Deka et al. 1988
	Muslim		104	0.1010	Deka et al. 1988
	Mixed		324	0.1235	Das et al. 1971
Manipur Brahmin		Manipur	108	0.0278	Singh et al. 1986
Meitei		Manipur	626	0.101	Singh et al. 2010
Hill Kabui		Manipur	270	0.035	Singh et al. 2010
Koireng		Manipur	174	0.029	Singh et al. 2010
Simte		Manipur	164	0.012	Singh et al. 2010
War Khasi		Meghalaya	170	0.0178	Present study
Bhoi Khasi		Meghalaya	201	0.1194	Present study
Khynrium		Meghalaya	203	0.1084	Present study
Lyngam		Meghalaya	222	0.4099	Present study
Garo		Meghalaya	209	0.2943	Present study
Pnar		Meghalaya	301	0.0631	Present study
War Jaintia		Meghalaya	105	0.1429	Present study
Rabha		Assam	227	0.2996	Present study
Angami Naga		Nagaland	201	0.0522	Present study

DISCUSSION

Systematic population studies concerning the distribution of abnormal hemoglobin in Northeast India (Das et al. 1971, Flatz et al. 1972; cf. Deka et al. 1988) began with the objective to test the hypothesis of a correlation between high prevalence of HB E and Austro-Asiatic-speaking populations (Flatz 1967; cf. Deka et al. 1988). According to this hypothesis Hb E had emerged in an Austro-Asiatic population and subsequently both the gene and language diffused concomitantly throughout Southeast Asia (Deka et al. 1988). High frequency of Hb E among the Lyngam and Garo confirmed the hypothesis as both these populations bear Austro-Asiatic heritage.

It was suggested that Hb E was spread to Northeast India by Austro-Asiatic migration in the prehistoric past (Deka et al. 1988). However, high frequency of Hb E among Tibeto-Burman populations of Assam in subsequent studies (Das et al. 1975, 1980; cf. Deka et al. 1988) led to reconsideration of this proposal. Considerably high frequency of Hb E in the Rabha (0.2202) found in the present study corroborate this finding. In this respect the view of Deka et al. (1988) can be mentioned herewith:

> *"Reasons for the high frequency of the Hb E gene are possibly the cumulative effect of selection and normal physical fitness of its carriers".*

High frequency of Hb E is found among the Austro-Asiatic (Lyngam and Garo) and Tibeto-Burman (Rabha) both in the present study. Thus, high incidence of Hb E in three population groups in the present study may be due to founder effect or local inbreeding.

CONCLUSION

Findings of this study indicate that the studied nine populations vary among each other in terms of prevalence of Hb E gene. Though prevalence of this gene is in low frequency among these groups, two Austro-Asiatic populations namely the Lyngam and Garo and one Tibeto-Burman group namely the Rabha shows considerably higher prevalence of Hb E. It is generally agreed upon the hypothesis that Hb E had emerged in an Austro-Asiatic population and subsequently both the gene and language diffused concomitantly throughout Southeast Asia. High incidence of Hb E in three population groups in the present study may be due to founder effect or local inbreeding. However, the cumulative effect of selection and normal physical fitness of its carriers also plays important role behind this.

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ETHICAL CLEARANCE

Present work got ethical clearance from IHEC (Institutional Human Ethics Committee) of Anthropological Survey of India, Ministry of Culture, Government of India.

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DISCLOSURE

The authors declare no conflicts of interest in this work.

REFERENCES

Das BM, Chakravarti MR, Delbruck H, Flatz G. 1971. High prevalence of hemoglobin E in two populations in Assam. *Hum. Genet.*, 12: 264-266.

Das BM, Deka R, Flatz G. 1975. Predominance of the hemoglobin E gene in a mongoloid population in Assam (India). *Hum. Genet.*, 30: 187-191.

Das BM, Deka R, Das R. 1980. Hemoglobin E in six populations of Assam. *J. Indian Anthrop. Soc.*, 15: 153-156.

Das MK, Dey B, Roy M, Mukherjee BN. 1991. High Prevalence of Hemoglobin E in Three Populations of the Malda District, West Bengal, India. *Hum. Hered*., 41: 84-88.

Deka, R. 1981. Fertility and Haemoglobin genotypes: A population study in Upper Assam (India). *Hum. Genet.,* 59: 135-136.

Deka R, Gogoi BC, Hundrieser J, Flatz G. 1987. Hemoglobinopathies in Northeast India. *Hemoglobin*, 11: 531-538.

Deka R, Reddy AP, Mukherjee BN, Das BM, Banerjee S, Roy M, Dey B, Malhotra KC, Walter H. 1988. Hemoglobin E distribution in ten endogamous population groups of Assam, India. *Hum. Here*., 38: 261-266.

Flatz G. 1967. Hemoglobin E: Distribution and population dynamics. *Hum. Genet*., 3: 189-234.

Flatz G, Chakravartti MR, Das BM, Delbruck H. 1972. Genetic Survey in the populations of Assam. I. ABO blood groups, glucose-6-phosphate dehydrogenase and hemoglobin type. *Hum. Hered.*, 22: 323-330.

Mukherjee BN, Walter H, Malhotra KC, Chakraborty R, Suber R, Banerjee S, Roy M. 1987. Population genetic study in ten endogamous groups of West Bengal, India. *Anthropol. Anz*., 45: 239-254.

Saha N. 1990. Distribution of Hemoglobin E in Several Mongoloid Populations of Northeast India. *Human Biology*, 62 (4): 535-544.

Saha N, Bhattacharyya SP, Mukhopadhyay B, Bhattacharyya SK, Gupta R, Basu A. 1987. A genetic study among the Lepchas of the Darjeeling area of Eastern India. *Hum. Hered*., 37: 113-121.

Singh KS, Mukherjee BN, Walter H, Lindenberg P, Gilbert K, Dannewitz A, Malhotra KC, Banerjee S, Roy M, Dey B. 1986. Genetic markers among Meiteis and Brahmins of Manipur, India. *Hum. Hered*., 36: 177-187.

Singh MR, Choudhury B, Singh S. 2010. Haemoglobin E Distribution in Four Endogamous Populations of Manipur (India). *Eurasian J. Anthropol*., 1(2): 109-117.